MEASURES TO ADDRESS THE IMPACT OF COMPUTER TECHNOLOGY ON LESSER DEVELOPED COUNTRIES

HEARINGS

BEFORE THE

SUBCOMMITTEE ON
INVESTIGATIONS AND OVERSIGHT

AND THE

SUBCOMMITTEE ON
SCIENCE, RESEARCH AND TECHNOLOGY

OF THE

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SCIENCE AND TECHNOLOGY
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*On assignment to Budget Committee for 97th Congress.

CONTENTS

WITNESSES

	Page
May 19, 1982:	
Jean Jacques Servan-Schreiber, chairman, World Center for Computer Science, accompanied by Dr. Samuel Pisar, vice chairman; Prof. Nicholas Negroponte, executive director; Prof. Seymour Papert, chief scientist; Prof. Raj Reddy, associate director; and Prof. Edward Ayensu, associate director	6
July 15, 1982:	
Ron Boring, marketing director for developing countries, Apple, Inc	78
Dr. Alan Kay, vice president/chief scientist, Atari, Inc	91
James D. Phillips, Director, Office of Communications and UNESCO Affairs, Bureau of International Organization Affairs, Department of State	106
Curt Farrar, Deputy Assistant Administrator for Research, Agency for International Development	111
Kalmann Schaefer, Special Assistant to the Chairman for International Affairs, Federal Communications Commission	121
James Oliphant, Intel Corp	132
Michael Goldhaber, Institute for Policy Studies	169
Appendix—Additional submitted for the record	183

MEASURES TO ADDRESS THE IMPACT OF COMPUTER TECHNOLOGY ON LESSER DEVELOPED COUNTRIES

WEDNESDAY, MAY 19, 1982

HOUSE OF REPRESENTATIVES, COMMITTEE ON SCIENCE AND TECHNOLOGY, SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT, SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY,

Washington, D.C.

The subcommittees met, pursuant to notice, at 9:13 a.m., in room 2318, Rayburn House Office Building, Hon. Albert Gore, Jr. (chairman of the Subcommittee on Investigations and Oversight) presiding.

Present: Representatives Gore, Shamansky, Volkmer, Walker, and Skeen.

Mr. GORE. The subcommittees will come to order.

I would like to welcome our guests and say good morning to everyone present.

One of the prime efforts of this subcommittee has been to closely examine various aspects of international technology transfer, particularly the public policy dimensions. In the past, we have focused on commercial technology and trade with Mexico and China and more recently have probed both legitimate and illegitimate technology transfers to the Eastern bloc countries, especially to the Soviet Union.

So today marks a unique opportunity to embark upon an exploration of the transfer of communications technology in particular and to add a new dimension by asking the question, "What is special about transferring technology to the Third World?"

While this committee has recently commenced a study of technology transfer to the Middle East, more remains for congressional focus, and having our distinguished representatives from the World Center in Paris affords us a unique opportunity to further our inquiries.

In particular, we wish to focus on the following questions: First, what challenge does the center represent? Is it a model we should emulate or cooperate with? Second, how does the World Center fit into the various initiatives that are taking place under the auspices of the United Nations and other international forums?

Third, because one of my chief personal concerns is that the United States take every advantage of the technical edge it cur-

rently enjoys in computer technology, I would like to broach the provocative question of a brain drain in reverse, in that today's panel consists of three noted computer scientists from American institutions who have gone to France to participate in this bold experiment.

I would like to note, also, that this is not the only day of our inquiry into this subject. At a later date we will be convening to hear from other distinguished observers from business, government, and academia to pursue this issue further and to examine American initiatives.

I would also like to thank our guests for taking the trouble to appear here today and provide us with this opportunity, and also add that I hope that during this hearing we will be able to also discuss some of the broader questions that Mr. Servan-Schreiber and other members of this panel have touched upon.

We are in the midst of the most rapid period of change in the history of mankind, and we need more people who are willing to look out on the horizon and try to envision the choices that are available to us. The world is a system, and we cannot fully understand our place in the world without reference to the operation of the larger world system.

Mr. Servan-Schreiber has looked at that larger world system and attempted to define our proper place in it, and I am looking forward to a very exciting discussion today.

I would like to call on our ranking minority member, Mr. Walker, for comments at this time, and then we will go to the witnesses.

Mr. WALKER. Thank you, Mr. Chairman.

I join with you in welcoming our guests here today. I look forward to the kinds of documentation that this hearing will put on the record about two vital subjects: technology transfer, where legitimate questions have been raised in this country and across the world about just what the impact of that may be on our future and as it relates, in this particular hearing, to computer science, because it is apparent that computers are going to play a major role not only in business, industry, and government over the next several years but in the personal lives of nearly every citizen of the world.

And so, combining these two subjects into a hearing of this type, will hopefully give us a sense of perspective that will help this subcommittee in some of its future deliberations and help the full committee in assessing what some of the scientific developments are that we have to look at.

I thank you, Mr. Chairman.

Mr. GORE. I would ask unanimous consent that the prepared statement of Mr. Walgren, chairman of the Subcommittee on Science, Research and Technology, who will join us shortly, be inserted into the record at this point.

[The prepared statements of Mr. Walgren follow:]

OPENING REMARKS
HON. DOUG WALGREN
INTERNATIONAL TRANSFER OF COMPUTER TECHNOLOGY
MAY 19, 1982

I AM PLEASED TO CO-CHAIR THESE HEARINGS ON INTERNATIONAL TRANSFER OF COMPUTER TECHNOLOGY WITH MY COLLEAGUE CONGRESSMAN GORE, CHAIRMAN OF THE SCIENCE COMMITTEE'S INVESTIGATIONS AND OVERSIGHT SUBCOMMITTEE.

THE SCIENCE, RESEARCH AND TECHNOLOGY SUBCOMMITTEE HAS PURSUED, FOR THE PAST SEVERAL YEARS, THE POTENTIAL CONTRIBUTIONS AND CONSEQUENCES OF INFORMATION AND COMMUNICATION TECHNOLOGIES IN EDUCATION AND HEALTH CARE. UNDER THE LEADERSHIP OF ITS PREVIOUS CHAIRMAN, CONGRESSMAN GEORGE E. BROWN, JR., THE SUBCOMMITTEE IDENTIFIED THE NEED FOR A COMPREHENSIVE U. S. INFORMATION POLICY AND A CENTRAL NATIONAL FOCUS TO DEVELOP AND IMPLEMENT A STRATEGIC PLAN FOR INFORMATION POLICY AND RESEARCH. THESE POINTS HAVE BEEN THE FOCUS OF H.R. 3137 NOW BEFORE THE SUBCOMMITTEE FOR CONSIDERATION, AND HAVE BEEN REVIEWED IN HEARINGS ON THIS BILL IN MAY AND JUNE OF LAST YEAR.

THE SUBCOMMITTEE IS ESPECIALLY PLEASED TO HAVE THIS OPPORTUNITY TO LEARN FROM THE WITNESSES TODAY ABOUT THE NEW WORLD CENTER FOR MICROCOMPUTER SCIENCE AND HUMAN RESOURCES ESTABLISHED BY THE GOVERNMENT OF FRANCE. I UNDERSTAND THE CENTER WILL PLACE MAJOR EMPHASIS ON COMPUTER EDUCATION AND TRAINING THROUGH PILOT PROJECTS IN INDUSTRIALIZED COUNTRIES AND THE THIRD WORLD. MANY BENEFITS CAN BE DERIVED FROM SUCH A CONCEPT DESIGNED TO TRANSFER BOTH TECHNOLOGY AND INFORMATION.

WE WILL BE INTERESTED TO LEARN WHAT SYSTEMS, TOOLS AND NETWORKS THE CENTER PLANS TO USE TO ACHIEVE THEIR COMPUTER EDUCATION AND TRAINING GOALS. AS OUR SUBCOMMITTEE'S PREVIOUS HEARINGS HAVE POINTED OUT, CAREFUL ATTENTION NEEDS TO BE GIVEN TO MAXIMIZING THE BENEFITS AND MINIMIZING THE DISBENEFITS OF COMPUTER EDUCATION.

AS STATED IN THE NORA-MINC REPORT, THE COMPUTERIZATION OF SOCIETY, PREPARED FOR THE FRENCH GOVERNMENT IN 1978, "ONLY A DELIBERATE POLICY OF SOCIAL CHANGE CAN BOTH SOLVE THE PROBLEMS RAISED BY TELEMATICS AND UTILIZE ITS POTENTIAL." THUS, WE WILL ALSO BE INTERESTED TO LEARN FROM THE CENTER'S PROPOSED PILOT PROJECTS HOW CONFLICTING VIEWS CONCERNING EQUITY, CIVIL LIBERTIES, COMPETETIVENESS, AND TRANSBORDER DATA FLOW CAN BE RESOLVED.

THE WORLD HAS BECOME INCREASINGLY INTERDEPENDENT AS A RESULT OF THE RAPID CONVERGENCE OF INFORMATION AND COMMUNICATION TECHNOLOGIES. IN A WORLD WHERE THE EMPLOYMENT OF NEW TECHNOLOGY HAS BOTH ECONOMIC AND STRATEGIC ADVANTAGES, ACCESS TO EQUIPMENT AND SERVICES IS AN ISSUE OF INTERNATIONAL IMPORTANCE. IN LIGHT OF INCREASING RESTRAINTS ON RESOURCES WORLDWIDE, SOME NATIONS, INCLUDING THE U.S., ARE BEGINNING TO QUESTION WHETHER STRONGER CONTROLS NEED TO BE PLACED ON THE TRANSFER OF TECHNOLOGY AND TECHNICAL INFORMATION.

DEVELOPING COUNTRIES AGREE THAT SATELLITE TECHNOLOGY CAN BRING VALUABLE SCIENTIFIC AND TECHNICAL INFORMATION TO REMOTE AREAS TO BE USED IN PROMOTING DEVELOPMENT. ON THE OTHER HAND, THIS INFORMATION TRANSFER IS ALSO PERCEIVED AS AN INTRUSION ON LOCAL SOCIAL

VALUES AND THE EROSION OF INDIGENOUS CULTURES. THE FRENCH COMPUTER CENTER WILL NO DOUBT BE CONFRONTED WITH A WIDE VARIETY OF SOCIAL, CULTURAL, AND POLITICAL ISSUES. WE HOPE THEIR REPRESENTATIVES HERE TODAY WILL CONTINUE TO SHARE WITH THE U. S. AND OTHER NATIONS THE LESSONS LEARNED AND THE SOLUTIONS WHICH EMERGE. THE NEED FOR COORDINATION AND COOPERATION AMONG GOVERNMENTS IN THE DEVELOPMENT OF INTERNATIONAL COMMUNICATIONS AND INFORMATION POLICY HAS A LONG HISTORY OF LIMITED SUCCESS. IMMEDIATE ATTENTION MUST BE GIVEN TO IMPROVING THAT RECORD.

Mr. GORE. I would like to welcome our other colleagues and introduce our witnesses.

Mr. Jean Jacques Servan-Schreiber is president of the Centre Mondial Informatique et Resources Humaines, and forgive my pronunciation, if you would, accompanied by Prof. Nicholas Negroponte, executive director of the center; Prof. Seymour Papert, chief scientist; Prof. Raj Reddy, consultant and member of the board of directors; Prof. Edward Ayensu, member of the board of directors; and Dr. Sam Pisar, attorney and vice president of the board of directors.

Before calling on Mr. Servan-Schreiber for his statement, let me just say a couple of words about this distinguished panel and encourage my colleagues to question each of them.

Dr. Pisar is an international lawyer based in Paris and New York, a board member and vice chairman of the World Center, and he has authored two books that have influenced our thinking: "Of Blood and Hope" and "Coexistence and Commerce."

Prof. Seymour Papert is foremost pioneer in research on the application of personal computation to education and training at all ages and in all cultures. He is scientific director of the center and most recently author of the book "Mindstorms," which has received an enthusiastic audience here in the United States. I see people carrying it around quite frequently in the Halls of Congress.

Prof. Nicholas Negroponte, until recently director of the Computer and Communications Laboratory at MIT, now the director general of the center, has participated from the beginning in the shaping of our ideas about computers.

Prof. Raj Reddy from India is the director of the Robotics Institute of Carnegie-Mellon University and has also participated from the beginning. He directs the shaping of programs for people in jobs displaced by robots.

Prof. Edward Ayensu of Ghana, president of the Network of African Scientists, a director of research at the Smithsonian Institution, is collaborating in the center's programs for the Third World.

It is an exciting group of people, and I know that the atmosphere of excitement that has brought so many people to the center is one

that will be sustained. We are looking forward to our interchange with you today.

At this point, I want to invite Mr. Servan-Schreiber to present prepared remarks on behalf of all of the witnesses that we have here today.

Mr. Servan-Schreiber, it is a distinct honor for us to have you here.

Did you want to make a statement, Joe?

Mr. SKEEN. Thank you, Mr. Chairman.

No; I do not have any statement.

Mr. GORE. All right.

Mr. SKEEN. I just want to compliment you on your pronunciation. [Laughter.]

When the order comes, I will join you with it.

Mr. GORE. All right.

Mr. Servan-Schreiber, we are most honored to have you here, and I am personally going to do everything possible to make certain that the Members of our House and Senate are made fully aware of the ideas which are being presented here.

Please proceed.

STATEMENT OF JEAN JACQUES SERVAN-SCHREIBER, CHAIRMAN, WORLD CENTER FOR COMPUTER SCIENCE, ACCOMPANIED BY DR. SAMUEL PISAR, VICE CHAIRMAN; PROF. NICHOLAS NEGROPONTE, EXECUTIVE DIRECTOR; PROF. SEYMOUR PAPERT, CHIEF SCIENTIST; PROF. RAJ REDDY, ASSOCIATE DIRECTOR; AND PROF. EDWARD AYENSU, ASSOCIATE DIRECTOR

Mr. SERVAN-SCHREIBER. Mr. Chairman, gentlemen of the Congress, we have the honor, my colleagues and I, of appearing before you to address issues of really vital importance that you have, yourself, defined in your official letter of invitation.

Our hope in coming here this morning together to debate with you is that the common vision that might help master some aspects, at least, of the ongoing crisis could start from this hearing.

Since it is becoming increasingly evident that in order, if there is any hope—and there must be—to stem the forces of dislocation that undermine our economies and societies here and elsewhere, a global approach must be conceived and implemented, a kind of "planetary new deal" to harness the most recent technologies—this is your subject and ours—to the training and development of individuals, of human beings, and not only as of now, the processes of production.

Now, that your hearings are very timely is shown by the fact that you have in mind, gentleman: they fall exactly 2 weeks prior to the Versailles summit of heads of state of the seven major industrial countries including, of course, America and France. The subject that you have put to the debate this morning and invited us to address with you is No. 1 on the agenda of the Versailles summit: the effects of new technologies and the creation of new jobs.

Now, you asked three questions in your letter. Your first question is, what are the reasons and concepts that have led the French President, Mr. Francois Mitterand, to create, at the beginning of this year, very recently, this World Center.

The French President has expressed himself on exactly this subject in Europe, in Japan, in Canada, where I was privileged to accompany him, as well as in the Third World countries, and black Africa now—I mean this day—where I am going to join him from Washington tomorrow.

The reasons for his initiative, to answer your questions, emerge from a global vision. Very briefly stated, the first reason is his view, and our view, that a close organic link exists, or should exist, between technological progress and social progress. If this link does not exist, if these two progresses do not go hand in hand, then we go from crisis to crisis on a planetary scale. This is what we are witnessing today.

The symptoms are always described in classical terms: inflation, lowered productivity, fall of investments, mounting unemployment, shrinking international trade, et cetera, et cetera; all words that recall the routine description of the Great Depression of 50 years ago.

In President Mitterand's analysis and ours, a very different aspect should be regarded today. We believe that the key part of the problem that we have to face stems from the fact that the savage, powerful forces of the new scientific and technological revolution that you have in mind so profoundly have not been tamed and cannot be tamed unless we conceive and guide a pattern of sociological, educational, and cultural change of similar scope and strength. The ambition of our World Center is modestly to contribute to this process.

His second reason, and ours, is the obvious incapacity of the world during all the 1970's to face the explosive scientific development of automated systems increasingly displacing in all fields the work of human beings.

The figures you all have in mind. Let us just take one or two for the measurements of the, let's say, not the drama, the adventure that we are all living together and, hopefully, shall be able to lead together.

There are today in our countries of the OECD, the so-called developed countries, the rich countries, the privileged countries, more today than 30 million unemployed, and the level of unemployment in this country, as in Western Europe, is approaching 10 percent of the active population.

Given, furthermore, the growth of productivity that comes precisely from new technologies in this decade—in this decade—of the 1980's, all experts agree that at least 25 million present jobs will be lost, so that we are facing on the horizon, a very short horizon, in a very few years, an army in the privileged world of 50 million jobless, signaling a situation of discouragement and possibly despair.

Can we reverse this trend? We believe that such means can be found, and we believe that they reside in the use of yet unexplored technologies for the development of the creative capacities of each human being—what we call the human resource.

To emphasize this hope, this concrete hope, that in front of you will be explained and sustained by qualified scientists, we have called, with President Mitterand, our center the Center for Computer Science and Human Resource. What is at stake is the most possible challenging opportunity.

As you know, more than one-third of the male and female workers of our countries—we are not speaking yet of the miserable majority countries of the world; we are speaking of the privileged countries, yours and ours—one-third of the workers of our countries will have to change jobs or become jobless by the end of this decade. They will have to be trained. We will have to find the tools to offer them superior jobs in the information society that is rapidly replacing, month by month, the industrial society of the obsolete factories crumbling in America, crumbling in Europe.

Let us not lose sight of the momentous fact that before the end of this century, 1 billion young people will arrive, in their turn, on the job market.

Now, the heads of the industrial states meeting in Versailles between June 4 and 6, less than 2 weeks from now, will discuss exactly this problem. It eclipses all others. These heads of states, most of whom I have seen discussing with President Mitterand in the last 2 months to prepare this summit, are discovering, Mr. Chairman, that the solution, if there is one—and there is one—passes to the invention of a new method to channel the modern scientific revolution toward human development.

The third and last reason for the center is the irreversible emergence around our small, privileged universe of Europe, America, and Japan, of the immense populations of the Third World, more than 3 billion people by the end of this decade, in search of the mere means of survival.

Here, Mr. Chairman and gentlemen of the Congress, two new factors call for the invention of new concepts, and you can be of decisive help for these inventions, with us and us with you.

First, the industrial world will not, cannot, find a way out of the crisis without making the Third World a true creative partner. I am moved and profoundly happy that you gave us the occasion—that you gave me the occasion—to say that in so many words and to emphasize that in the capital of the United States.

America, 40 years ago, looking at the world, had the fertile vision of the Marshall plan and decided to help Europe and Japan to reconstruct themselves to become creative partners, with the success that we all know.

Today, our countries together, the so-called developed world, must open an opportunity for all the countries of the Third World to become in turn our creative partners. We have no other possible partners for a new cycle of development and activities.

So this transfer of knowledge to this Third World—I am not saying transfer of technology, and we shall discuss that together. A transfer of something more subtle, more human, a transfer of knowledge, has become an absolute priority.

Second, it has become equally obvious to us and to you that nothing constructive can be accomplished in the Third World by sending to it plants and factories that have in the past created our wealth and our jobs. Such factories will henceforth be populated largely by robots or else go to bankruptcy.

So the inexorable law of international competition has effectively put an end, without people really knowing it clearly, to the mere notion of cheap labor. What kind of cheap labor, Mr. Chairman, can compete with robots that work night and day, that work with-

out salary, that work without fatigue, that work without social security, that work without unions or strikes? Men and women cannot compete with robots. There cannot be any more cheap labor. So they must be utilized, here and everywhere else, for their own faculties and capacities.

The development of this human resource must proceed on all continents at the same time. The problems and the resources of the Third World are of the same nature as ours, and the science of personal computation places at our disposal unprecedented means for the training of people everywhere, in all cultures, at all ages.

These are the basic concepts which have given birth to the World Center. They will be developed by the French President in 2 weeks before his guests at Versailles, the same way I summarized them for you and for our debate this morning, in the hope, today and in Versailles, to arrive, from a common analysis, to a common plan of action. We do hope today that the United States will find persuasive the point of view here outlined.

On your second question, I will be much briefer, because on the mission assigned to the World Center on which you asked us to explain, my colleagues here will be able to answer you in a more complete way, so I gave you, in the prepared paper, passages from our charter. I will not spend your time reading them, and we will discuss them very rapidly.

Now, your last question is in fact the central subject of our debate this morning, isn't it? How can the Government of the United States participate in or cooperate with the World Center's efforts?

What would be appropriate, it seems to us, is not only, as you suggest wisely, active American cooperation with the center in Paris but, through this cooperation, the establishment of an international network of similar centers.

We do not believe Paris is the capital of the world for 1 second. We believe the World Center in Paris is the first step toward a global network of such centers, starting with the United States; and, further, from that network, to the implementation of a policy aimed at the stimulation of a new worldwide economic activity and employment. No country can contribute more decisively to such a historical objective than the United States.

Your question is, therefore, fundamental, and it comes at the most opportune moment, when the main people leading their countries, responsible for the world, have to make fundamental decisions.

To answer you on these complex and foremost questions, I have the honor to be accompanied today by our colleagues that you have invited and you, Mr. Chairman, presented: Dr. Samuel Pisar, international lawyer, the known author of "Blood and Hope," our human bible for human survival, and vice chairman of the World Center; Prof. Seymour Papert, well known as a foremost pioneer in the application of personal computation to education and training at all ages, in all cultures, and, as you recall, the author of "Mindstorms."

Prof. Nicholas Negroponte, until recently director of the Computer and Communications Laboratory of MIT, has been proposed by myself, at the beginning of this year, to the President of France to

become the first executive director of our World Center. The decision of President Mitterand to nominate, at my suggestion, Professor Negroponte has no precedent, Mr. Chairman. No French institution of that scope, founded by France, with nine Cabinet ministers on its board, has ever had a foreigner as its executive director. This President Mitterand considered the wise decision to make, and it had a very beneficial impact on the French scientific community.

Prof. Raj Reddy from India, very well known here, director of the Robotics Institute of Carnegie-Mellon, has been participating from the beginning with us and directs the shaping of our programs for people in jobs precisely displaced by the robots, because he, of course, because of his origins, because of his science, has never been satisfied with developing robots if he cannot develop, at the same time, the human capacities for new jobs when people are displaced by the robots.

Prof. Edward Ayensu of Ghana, president of the Network of African Scientists, a director of the Smithsonian Institute, collaborates with our center regularly for formulating our policies for the Third World.

These personalities in front of you are at the World Center in Paris, complemented in our work, on our board, by other personalities. I will mention only a few: Dr. Abdul Salam from Pakistan, Nobel Prize winner in physics; President Senghor of Senegal, whom I will meet day after tomorrow; Prof. Francois Gros of the Pasteur and Weizmann Institutes; together with Minister Abdulatif Al Hamad of Kuwait; Prof. Keichi Oshima, who is in charge of the Tsukuba Institute in Japan, which we visited 3 weeks ago with the French President and Government, and other outstanding leaders in the fields of economics, science, culture, and politics, as well as, as I mentioned, nine French Cabinet ministers.

We all share the conviction that in the current conditions of the world crisis, a real renaissance can be brought forth from the widespread deployment of the creative faculties of each human being. This renaissance can take place if we have the wisdom and the audacity to implement the vision that I have briefly sketched in front of you and if we have the imagination and the realism to know that it should be implemented all over the world, not mainly, not uniquely in America or Europe; all over the world.

No one in this room, no one in this parliament, no one in our Parliament, no one in our country should forget for one instant that if we do not—I must emphasize this in Washington—if we do not elevate the Third World by a constant transfer of knowledge to the stature of a real creative partner, we shall, the so-called rich countries, become poorer and poorer, and we shall not find a way out of the crisis.

Much will depend, gentlemen of the Congress, on the leadership and determination that will come from this capital, from your great country that must now face very realistically what we once regarded as an American challenge.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Servan-Schreiber follows:]

TESTIMONY OF JEAN JACQUES SERVAN-SCHREIBER, CHAIRMAN, WORLD CENTER FOR COMPUTER SCIENCE AND HUMAN RESOURCES, ACCOMPANIED BY DR. SAMUEL PISAR, VICE CHAIRMAN; PROF. N. NEGROPONTE, EXECUTIVE DIRECTOR; PROF. SEYMOUR PAPERT, CHIEF SCIENTIST; PROF. RAJ REDDY, ASSOCIATE DIRECTOR, AND PROF. EDWARD AYENSU, ASSOCIATE DIRECTOR

My colleagues and I have the honor of appearing before you to address issues of vital importance as defined in your invitation of May 5, 1982. We hope that from this dialogue will emerge a common vision that might help master some aspects of the ongoing crisis.

It is becoming increasingly evident that in order to stem the forces of dislocation which undermine and depress our own economies and societies, and those elsewhere in the world, a global approach must be developed, a "planetary new deal" to harness the most recent technologies to the training and development of individuals, as well as the processes of production.

Your hearings are most timely in that they fall exactly two weeks prior to the Versailles Summit of Heads of State of the major industrialist countries. The subject you have chosen, touches directly on the weighty problems that will be on the agenda of the Versailles Summit: new technologies and new jobs.

I

You ask first in your letter, what are the reasons and concepts that have led President Francois Mitterand to create, in Paris, early this year, the World Center, an institution which, although originiated in France, is essentially international in its structure, composition and objectives.

The French President has expressed himself on this subject on a number of occasions, in Europe, Japan and Canada, where I was privileged of accompanying him, as well as in Third World areas such as black Africa, where I will join him from Washington tomorrow. The reasons for this initiative emerge from a global vision.

The first reason is his view that a close organic link exists, or should exist, between technological progress and social progress. If the two do not go hand in hand, there is a risk of continuous and uncontrolled crises on a planetary scale.

The symptoms are always described in classical economic terms: inflation, lowered productivity, fall of investments, mounting unemployment, shrinking international trade, etc., in short, the spectre of the great depression of the '30s. In our analysis there is, however, a very different aspect to all this. We believe that the key part of the problem stems from the fact that the savage forces of a scientific and technological revolution without precedent, have not been tamed yet, and cannot be tamed, unless we can conceive and guide a pattern of sociological, educational and cultural change of similar scope. The ambition of the World Center is to contribute to this process of adaptation.

The second reason is the incapacity of the world economic system, during the '70s, to arrest the aggravated social

crisis created by the explosive scientific development of automated systems which increasingly displace, in all fields, the work of human beings.

There are today, in the countries of the OECD alone, more than 30 million unemployed. The level of unemployment is approaching 10% in America as well as in Western Europe. Given the growth of productivity that results from new technologies, experts predict that by the end of the '80s an additional 25 million present jobs will be lost. Thus, if we limit ourselves to classical remedies within the closed circuits of the so-called developed world (Europe, the United States, Japan), an army of 50 million jobless will appear on the horizon and signal a situation of despair.

Faced with these perspectives, we must look for ways and means to reverse the trend whereby scientific progress turns against us, and to put it at the service of man.

We believe that such ways and means can be found. They reside in the utilization of new and as yet unexplored technologies for the development of the creative capacities inherent in each human being, the development of what we call "the human resource."

To emphasize this concrete hope, which is carried by the most qualified scientists, and which points the way to a possible Renaissance, we have included in our Center's name the words: "computer science and human resource."

What is at stake is not a humanitarian dream but a fundamental responsibility and a challenging opportunity.

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As you know, more than one-third of the male and female workers in our countries will have to change jobs by the end of the '80s. If we fail to put to use, quickly and effectively, all available scientific and technological means to retrain them for new jobs, superior jobs useful to the "information society" which is rapidly replacing the "industrial society", they will swell the restless and rebellious masses of tens of millions of unemployed. Let us not lose sight of the momentuous fact, that before the end of this century, a billion young people will arrive, in their turn, on the job market to demand a way to make a living.

The heads of state of the seven major industrial countries will meet at Versailles from June 4 - 6 to discuss this immense problem, the scope and gravity of which eclipses all others. They are discovering that the solution, if there is one, passes through the invention of a new method to channel the modern scientific revolution toward human development.

The third reason for the Center is the irreversible emergence around the small universe of the privileged countries, of the immense populations of the third world, more than three billion people by the end of this decade, in search of the means of survival. Here, two new factors call for the invention of new concepts.

1. The industrial world will not find a way out of the current crisis without making the third world a true partner

to its efforts. America, 40 years ago through the fertile vision of the "Marshall Plan," enabled a destroyed Europe and Japan to reconstruct themselves and become creative partners. Today, the industrialized countries must open an opportunity, in the interest of their own survival, to the countries of the third world, to become, in turn, creative partners. This transfer of knowledge has become an absolute priority.

2. It has become equally obvious that nothing constructive can be accomplished in the third world by endowing it with the kind of plants and factories that have, in other times, created wealth and jobs in our own societies. Such factories will henceforth be populated largely by robots, or else go down to bankruptcy. The inexorable law of international competition has effectively put an end to the notion of "cheap labor."

What kind of "cheap labor" can compete with robots that work day and night, without salary, without fatigue, without social security, etc.? Men and women, in the developing as in the developed world must, therefore, from now on, be utilized for their own faculties and capacities, and not as mere laborers.

Thus, the development of "the human resource" must proceed in the continents of the third world at the same time as it proceeds in our own countries. The problems and the resources are now essentially of the same nature and the science of personal computation places at our disposal unprecedented means for the training of people everywhere, and at all ages.

These are the basic concepts which have given birth to the World Center. They will be developed by President Mitterand personally next month, before his guests at Versailles in the hope of arriving, from a common analysis, at a plan of action. We hope that the United States will find persuasive the point of view we have outlined.

II

We can be much briefer with regard to your second question, namely, the mission assigned to the World Center, because my colleagues will be able to answer you more completely. Permit me only to quote a short passage from our charter.

> "Computer science and microelectronics technology have developed at a rhythm which renders obsolete all previous socio-economic predictions. This rhythm will accelerate...
>
> "Only one response will permit the era of industrial robots to turn into something other than social chaos: to engage that part of the information sciences, i.e. personal computation, which applies itself to the intellectual development of every man. We must do this in concert with the development of new means of personal communication and telecommunications...
>
> "The primary objective of the Center is to unite the social sciences with computer technologies, at a rate of development which exceeds that of automation. In particular, the Center must accelerate the design of concepts and inspire the construction of a truly personal computer with which any person can interact in a fashion comparable to human-to-human conversation, for purposes of personal training.

"Such personal development will be enhanced by the computing power, put at the disposal of large numbers of individuals and interconnected with advanced telecommunications. Far from being a factor of social and mental isolation, it should lead to the emergence of a world society in which the density and diversity of intellectual exchanges will exceed anything we have known before...

"Our task is to augment the intellectual universe of each individual not only to help achieve full employment in the classical sense, but to achieve full employment of each person's faculties as well. The Center will favor the emergence of this immense, new potential.

III

Your last question is, in fact, the central subject of our debate: How can the Government of the United States participate in or cooperate with the Center's efforts?

What would be appropriate, it seems to us, is not only active American cooperation with the Center in Paris, but, through this cooperation, the establishment of an international network of similar Centers for the development of human resources, starting with the United States; and further, the implementation of a policy aimed at the stimulation of world-wide economic activity and employment. No country can contribute more decisively to such an objective than the United States.

Your question is, therefore, fundamental, and it comes at a most opportune moment. To discuss it, several person-

alities associated with the World Center are here before you today.

Dr. Samuel Pisar, international lawyer based in Paris and New York, board member and Vice-Chairman of the World Center, and author of two books that have influenced our thinking: "Of Blood and Hope" and "Coexistence and Commerce".

Professor Seymour Papert, foremost pioneer in research on the application of personal computation to education and training, at all ages, and in all cultures, Scientific Director of the Center and author of the book "Mindstorms".

Professor Nicholas Negroponte, until recently Director of the Computer and Communications Laboratory at MIT, now the Director General of the Center, who has participated from the beginning in the shaping of our concepts.

Professor Raj Reddy, from India, Director of the Robotics Institute of Carnegie-Mellon University, who has also participated from the beginning, and directs the shaping of programs for people in jobs displaced by robots.

Professor Edward Ayensu, of Ghana, President of the Network of African Scientists, a director of research at the Smithsonian Institution, who collaborates in the Center's programs for the Third World.

These personalities are complemented, on the Board of the Center, by Dr. Abdul Salam from Pakistan, Nobel Prize winner in Physics, President Leopold Senghor of Senegal, Professor Francois Gros of the Pasteur and Weizmann Institutes, Minister Abdulatif Al Hamad of Kuwait, Professor Keichi Oshima of the Tsukuba Institute of Japan, established recently in conjunction with our Center, and other outstanding leaders in the fields of economics, science, culture and politics, as well as nine French Cabinet Ministers.

We all share the conviction that in the current conditions of world economic and political crisis, a Renaissance can be brought forth from the widespread deployment of the creative faculties of each human being. This Renaissance will take place if we have the wisdom and audacity to implement the vision we have sketched through a common effort, across the planet.

Much will depend on the leadership and determination that will come from this capital and your great country that must now face what we once regarded as an "American Challenge".

Mr. GORE. Thank you very much for a very powerful and provocative statement. I think it is a most important statement and one that we certainly need to hear and reflect upon.

Let me say, before beginning questions, that the administration of President Reagan has expressed a great deal of interest in your ideas and in your visit to this country, and indeed, representatives from the White House, I believe, are here and also will be looking forward to an interchange with you on another occasion later today.

They are quite aware of the presence of these ideas on the agenda of the Versailles conference and are looking forward to that discussion.

Let me begin by asking you to disarm your critics. Sometimes when you come into a new environment and address a new audience, it is best to begin by putting at ease those who may harbor some cynicism.

Let me say that I do not. I believe that whatever faults may appear when you try to put your ideas in reality, the idea itself is an extremely powerful one. I was taught in the Bible, where there is no vision, the people shall perish. We stand on the threshold of a new era which has great capacity for good or ill, and we must seek to envision the choices before us and try to see how we can choose wisely.

I think you are absolutely correct in saying that we are peoples of one world, and those in misery and degradation must have a role in the new system that we attempt to choose.

Now, with that in mind, some in America—and I would invite the Americans on the panel to respond to this as well—some in America look upon this world center with some apprehension. Maybe that is not the right word, but let me go through their criticisms one by one and ask you to respond and disarm your critics.

First, they suspect that the world center is, in large part, a stalking horse for the French communications and computer companies. Who would like to respond to that? Dr. Pisar? You are in fact a citizen of both countries, is that correct?

Dr. PISAR. No, sir, I am a citizen of the United States.

Mr. GORE. Oh, you are a citizen of the United States and a former staff member of the Joint Economic Committee and the Senate Commerce Committee, is that correct?

Dr. PISAR. And, if you will allow me, I might say, a citizen of the United States by the will of the people because it was voted to me by the two Houses of Congress.

Mr. GORE. A distinct honor, and we are glad to hear from you.

Dr. PISAR. And therefore, with these perspectives of an American citizen and as someone who has been present at the creation of all of this, from the beginning, I can give you my personal assurance that the way this idea came about and was gradually implemented, there was absolutely nothing nationalistic at the origin.

The center grew out of a long period of thought and reflection within a small group that Mr. Servan-Schreiber and I formed about 3 years ago called the Paris Group, a group in which participated several other Americans, Japanese, Arabs.

What motivated us was a preoccupation with a constantly worsening world crisis, abysmal unemployment in Western Europe and

in other parts of the world, and the realization that the conventional remedies would no longer do.

We asked ourselves, could some new resources be tapped; could some new ideas be developed that would lead political leaders to a different kind of approach, a different kind of look?

Without imposing on your time, I can tell you, sir, that we have met and meditated in a number of countries: The United States—specifically, in California—where we spent the better part of a summer; in the Massachusetts area which is so central to high technology. We have been in Japan, in the Arab Gulf. We have met with the sophisticated scientific leaders of Israel and of other countries.

We proceeded from the premise, and I might say that I have a personal outlook on this, that the world could once again collapse, first economically and then socially and politically unless something were done to stem the tide of hopelessness and despair. So, starting from these premises, a number of us concerned by this, and advised and assisted by some of the foremost scientists in the United States and in other countries, some of whom are present at this table, we have gradually shaped this concept, a concept which was translated into political life in a first act of statesmanship by President Mitterand, but in an act of statesmanship which made it absolutely clear at a solemn meeting at the Elysee Palace, the White House of France, to which he invited scientists and personalities from all over the world, that this is not intended to be a French institution; that even though its origins are French, its structure, its scope, its staff would be international and worldwide in scope and that it would be a center that would, in effect, be a kind of catalyst that might, with luck, have a favorable social and economic impact which would do something about helping to pull the industrialized world out of its bankruptcy—may I say it—and the Third World out of its misery.

Now, this may sound a little ambitious, but this is the kind of dream that was projected out of this Paris group which was at the origin and at which I, as an American citizen, had the privilege of sitting.

Mr. GORE. Well, it is a good time for such ambition.

In other words, the answer to the question which I posed in behalf of some critics is that it is not really a choice between France getting more contracts in the computer and communications industry and the United States doing it; it is a much larger question: Is the world economy going to be transformed in a way that will allow the Third World to participate in a new era of growth that will revolve around computers and communications technology?

Professor Ayensu, would you want to respond to this matter? Or Professor Reddy, either one.

Mr. AYENSU. I will be delighted to do that, sir.

I think a number of people often forget that the basic concepts that we are talking about today have serious ramifications as far as the Third World is concerned.

I have often told my colleagues here that regardless of what we do here in the United States and in Europe, we must remember that our eternal well-being is going to depend upon our ability to

try to help the developing countries to move from a very low energy level of activity to a much more decent way of life.

Now, this, in my judgment, should not be looked at as if we are being so philanthropic from this part of the world to the other part. I think it is a very businesslike proposition that has to be looked at very carefully.

To digress just a little bit, in January I had the opportunity of having lunch with the IMF managing director and the senior vice president of the World Bank finance and a number of the European executive directors of the Bank and the Fund. I told them that it is amazing that, over the years, we have tried to lend moneys and give aid to developing countries, and things seem to be working in a way that is unsatisfactory to all of us.

The developing country people are becoming more and more impatient because you are having your own problems, too, and you cannot, obviously, turn your attention to look at the misery of others. However, we have a glimmer of hope, and the glimmer of hope is that this latter part of this century and obviously the beginning of the 21st century and beyond, we have got a fantastic opportunity of translating a number of the technological innovations into realities as far as developing countries' economic, social, and human developments go.

They were rather intrigued, and they wanted me to elaborate on it, and I said, Let us forget about the United States and Europe and Japan and look at countries that are similar in terms of their sociology, and so on, with a number of the developing countries, like South Korea, like Taiwan, Singapore.

If you look at these countries very carefully, you will find out that one of the reasons why they have been able to move forward in recent years is that they have taken seriously the information industry and what the microcomputer technology could do to help in the areas of policy planning, in the areas of agriculture, health, population, and so on.

I think the people in the developing world should not be looked at as if they are too dumb. The truth of the matter is that if we are able to help them to get a feel of these technologies, a number of you might be surprised because, remember, the inventive spirit of a lot of these countries has been killed for many years, for various reasons that we do not have to discuss here.

But I believe strongly that, from my own experiences, if we are able to get to them very quickly, we may help to transform the world, and it may be a much, much better place for all of us.

Thank you.

Mr. GORE. Yes.

Let me ask you, Professor Negroponte, you have an eminent position in the scientific community in the United States and have won respect from your peers. You decided to go to be the director of this World Center, at least in part because you felt that this initiative was more exciting than anything happening in the United States. Is that correct?

Mr. NEGROPONTE. Yes, it is correct.

Mr. GORE. And you think that the United States should undertake an initiative similar to this one, is that right?

Mr. NEGROPONTE. Absolutely.

Mr. GORE. Coming back to my question, and perhaps it is not an appropriate way to begin, but I have started this way, you have encountered some of the apprehensions—perhaps it is even jealousy—in the American scientific community, but I think that it includes many other things as well. You have encountered this attitude, have you not, toward the world center?

Mr. NEGROPONTE. For sure. I mean, we have encountered it quite dramatically, and in fact there has been, in my opinion, some reliatory funding and cutting of our budgets at MIT because of my going to Paris. I do not think that should be the subject of this meeting, but it is certainly one that concerns me greatly.

Mr. GORE. Yes, I am familiar with the details of that specific concern, and I am interested in pursuing it. But how do you explain this attitude on the part of some in the United States?

Mr. NEGROPONTE. I think the attitude is very simple. It comes from the words that you have been using frequently that have to do with technology transfer. It comes from the notion of technology transfer. If you think that technology transfer is a one-way street, then we have a very severe problem, and then there is in fact something to be alarmed by.

But it is my deep belief that it is not a one-way street. That comes from having made over seven trips to Japan in the past 12 months and yet more to Europe, long before I was involved with the world center. There is a lot of technology that we have to learn and bring to this country.

In France, in particular, they have an enormous lead in areas of telecommunications, the use of telecommunications in the consumer marketplace, and you probably are as familiar as I with it.

So if you believe that transfer of technology is a two-way street, then I believe you dispel most of the criticism which in fact has surrounded the project right now, particularly vis-a-vis people like myself prepared to take a 2-year leave of absence from MIT to go there and become the director.

Mr. GORE. Professor Papert, could you address the same question?

Mr. PAPERT. Well, maybe I would like to shift the question a little.

Mr. GORE. Fine.

Mr. PAPERT. I think focusing on technology transfer and on technology in fact distorts or hides the real issues.

I think Mr. Servan-Schreiber correctly tried to refocus it. The point is not technology but knowledge, and the issue here is the creation of, I would say, a new industry which you would call the knowledge industry. Creating this involved bringing together intellectual trends, some of which come from computer science and have roots in technology, but some of which come from, in fact most of which come from many other sources in psychology and anthropology and concerned with cultures and their dynamics and concerned with establishing the kind of relationships between people and between countries that could allow the growth of new approaches to knowledge, new relations between knowledge and the individual, knowledge and society, knowledge and technologies.

These are the clusters of questions that are raised by the existence of the center. Now, having made that distinction, let me go to your questions.

Do we encounter criticism? I have run into two kinds of criticism, one kind which I would regard as narrow-minded and a symptom of serious problems we have and criticisms of the sort that, will this not lead to a transfer of technology out of the United States? I think that this really misses the point in quite a fundamental way.

In addition to what Professor Negroponte said, that there are technologies which we can draw from the other side, I would like to draw attention to the fact that, in the areas of human sciences and the areas of thinking about psychology and thinking about the sociology of technologies and the anthropologies of technologies, while the United States is eminent, it is in no way in a monopoly and has as much to learn from many others as it has to offer.

I think it is in that area that placing an initial focus of activity in Paris has very special qualities from the point of view of bringing together these trends. I think that the attempts to grow within the U.S. adaptations of computers and information industries to education have been singularly limited in ways that are tied with the rather limited and technologically oriented trends that, until recently, dominated much of the thinking in the United States in psychology. I think that the uses we have tried to make of computers in education, on the whole, have been rather narrow and not of such a nature as to even address, let alone solve, the crucial problems of how to reformulate knowledge in ways that can allow a true sharing between advanced, already industrially developed countries and the countries that we call developing only because they are less developed than we in technology but maybe have much to teach us in other areas.

As soon as we focus on the components other than technology, the appearance one might have that in the United States we are the preeminent leaders, and any flow is almost sure to be, if not one way, very largely outwards from here; that position is radically reversed as soon as you think of the technology in the wider context of all these other areas of knowledge.

So much for the first kind of criticism, those based, I think, on a rather narrow view of the problem and the failure to see it in all its dimensions.

I have heard other kinds of criticisms. It is almost a reversal. I think that in listening and talking to—which I have tried to do—many people concerned with the social sciences, with the growths of cultures and of individual people, I have spoken in the last few months, since the center has become concretized, with quite a number of people in different countries, and from this kind of quarter, I do hear criticisms that are of a sound and serious intellectual nature.

What the criticisms boil down to, correctly, is that what is being undertaken by the center is a momentously difficult task. Jerry Wiesner, in the opening meeting of the center, either made a speech or sent a message comparing it, in the magnitude of the task, with the decision made to place a man on the moon at the

time when he was science advisor to President Kennedy. The task is momentous.

That criticism that comes from realizing that we are undertaking something extremely difficult and that should be not undertaken lightly but should be seen in all its dimensions, I think, is a sound reminder to us of how hard a task we are undertaking. I think the only answer we can make to that is, we don't see any choice; that somebody has got to start somewhere, recognizing the difficulty of these problems.

Personally, I think that the importance of the center is going to be that, for the first time, because somebody has started, criticism about how difficult it would be, how difficult it is to transfer knowledge and bring cultures together would become focused on actually becoming engaged in an attempt, for the first time, really, to do it.

So I think that all their criticism is sources of intellectual energy and ideas which we will try to draw in, in the most construction way, into turning the center into a crystallizing point for an international movement of rethinking the problems of knowledge and its transfer.

Mr. GORE. Well, that is a very intelligent and helpful response, and I appreciate it.

Let's focus for a moment on this second area of criticism. As I said before, I agree with your response to it that it is far better to have a group of people trying to articulate this problem and articulate solutions to this problem, rather than having everyone shrug their shoulders and conclude that it is too big and too complex.

But let's try for a moment to flesh out in a little more detail how it is you hope to accomplish this larger task. How do you see the outlines? How would you describe the mechanism that you would like to create? What would the broad lines of commerce be and the exchange of ideas?

The question is a vague one. Do you want me to be more specific, or is that enough for you?

Mr. PAPERT. If you would like to be more specific, I could start with the specific——

Mr. GORE. All right. How is it going to work? [Laughter.]

Mr. PAPERT. Well, rather than, in the spirit of what I said before of trying to crystallize very difficult abstract questions by action, let me, instead of saying how is it going to work, focus on how it is working, on things that are actually happening right now, and use them as a way to capture some ideas of a more general sort.

Mr. GORE. Well, let me try to refine it differently, then, and I invite you to go ahead with that response, but let me try to focus the question a little bit better.

You see, and Mr. Servan-Schreiber sees, very clearly, a change taking place in the economies of the privileged countries. This is not just a temporary fluctuation in the pattern of recess and inflation; rather, it is a shift of tectonic plates, a basic, fundamental change in the means of production, in the organization of the economy, in the way our civilization goes about its business, a basic, fundamental change.

You see the forces of change, many of them technologically induced, you see the forces of change speeding up history. You see the need for us to try to control these forces of changes or at least

to try to consciously choose among the different alternatives that we have before us. So far, so good?

Mr. PAPERT. Yes.

Mr. GORE. Do you want to correct me or do you want me to—OK. Now, the world center, you hope, will be a place where informatiques, the application of computers and information sciences to politics, economics, and sociology, a place where informatiques will be shaped into an instrument that societies all over the world can use to create a better future, an instrument they can use to choose between the alternatives that are arrayed before us during this period of rapid change. Still so far, so good?

Mr. SERVAN-SCHREIBER. No.

Mr. NEGROPONTE. No.

Mr. PAPERT. Could we try to focus on, specifically, what kind of change we are talking about?

Mr. GORE. Well, yes, I want to get to that.

Now, you see that among these choices, robotics, the marriage of microprocessors and automation, is going to destroy millions, tens of millions, of jobs in the industrialized world.

You see the possibility that information science and an economy based on information transfer will be able to compensate for some of those jobs?

Mr. PAPERT. Let us make a correction.

Mr. GORE. All right.

Mr. PAPERT. I think that information transfers may be a good point to jump in with; there might be a misconception.

Mr. GORE. All right.

Mr. PAPERT. It is often said that the problem in the world is increasing quantities of information and how do we move it around. That might be our problem, but it is not the problem. The problem has to do with, let's call it learning, adaptability. The problem is increasing the ability of each individual in the world to be able to learn new things, very different things, very rapidly. This is critical.

Call it education if you like. I hate the word education because it conjures up images of a classroom, which is totally obsolete way of thinking about the transfer of knowledge. Let's rather call it learning.

It is obvious that if 25 million people are going to be displaced from their jobs, those people are going to have to learn something—new jobs or to live without jobs or to burn down the cities; whatever they are going to do, they are going to have to learn to do it.

I think that the conclusion I would draw from that, from the crisis situation, is that the problem of learning is, for the first time, one of the problems in the center stage of world politics, if you like; that, whereas, in the past it has been energy and armaments, with learning being relegated off side-stage somewhere, not the focus of major interest, not the focus of major summit meetings or congressional committees; I think this is what is changing, that we are moving into a phase of history where, for two reasons, the problem of learning becomes central: one, because technology has made it more urgent, and, two, because it so happens—coincidence, if you like—but it so happens that, for the first time, we have the techno-

logical infrastructure that permits us to be effective in changing the conditions under which learning happens. And that is radical.

Until now, learning has happened in very much the same way. Other technologies—television—it is same kind of relationship through the television screen as you always had in a classroom, somebody explaining something to you. The computer changes very totally the way in which people can learn, and that is what is radically different about the period that we are moving into.

Mr. GORE. The problem has an economic dimension, as you make clear. How do you see the give and take of the economy that replaces those jobs lost to robotics?

Mr. PAPERT. I don't think there is a blueprint that you can make for the whole world.

Mr. GORE. All right.

Mr. PAPERT. I think it is very clear that if you say—Japan is a country that does not have raw materials except gray matter in the heads. In Africa, there are countries that you might say have no raw materials, have no industrial base. What is the difference? Why is one dominating the world and why are the people in the other starving?

I think a simplistic answer, of course, but one that captures something is that the people in that country in Africa don't know how to do certain things that the people in Japan or the people in America do know how to do.

The key problem in thinking about what sorts of economy are possible in that country in Africa centers around the conditions under which the people in that country can come to do whatever is needed in particular plans for economic development.

This is what has been missing. When we have thought in the past about economic planning, we have applied the most sophisticated ideas to thinking about economic models for transfer of matter and energy and trade and dollars, but we have approached them with the most unsophisticated ideas about how learning could happen, ideas that have hardly changed since the ancient Greeks.

And so, schematically, I think that the refocusing, the new paradigm, is to promote the problem of understanding the opportunities for learning and how to make it happen from amateurism and prescientific conditions to something which, for the first time, can be tackled scientifically with powerful technology behind it.

And so, again, the center is important because it is really the first place where a relevant scale of resources has been made available for probing that kind of question.

Mr. GORE. Mr. Servan-Schreiber.

Mr. SERVAN-SCHREIBER. I would apply the fundamental remark made by Professor Papert that learning is now at the core of all activities, if I may, Mr. Chairman, to our field, our business, if you will, which is politics.

The leaders of the world and everyone concerned with the public interest, as you are, as we are, will have to learn and learn and learn all the time, and invent. To make it very precise, let us have rapidly a global vision.

A hundred years ago, this country, our countries, were largely agricultural countries. Most, by and large, all, of the active population was employed in agriculture. Today in the United States, 3

percent of the active population is employed in agriculture, although America is the most powerful agricultural country of the world—3 percent.

So this dramatic change of the employment of men that has taken one century to take place in this country and ours, this same phenomenon is going to take place, is taking place, within a decade or so from the industrial factory.

Mr. GORE. Manufacturing.

Mr. SERVAN-SCHREIBER. Manufacturing, people employed in the factories of manufacture.

Mr. GORE. May I just interject there, for those who have some problem accepting the reality of this change, Business Week magazine, a very conservative establishment publication here in this country had a cover story on computers about a month ago saying that there are now in this country 28 million manufacturing jobs, and by the year 2010, they expect only 3 million of those to remain.

So I think that it is unwise to ignore this prediction that the change in manufacturing will parallel the change in agriculture in terms of employment loss, except in a much shorter period of time.

Mr. SERVAN-SCHREIBER. Much shorter.

Mr. GORE. Yes.

Mr. SERVAN-SCHREIBER. Even shorter than Business Week predicted.

Mr. GORE. Perhaps.

Mr. SERVAN-SCHREIBER. This cover story was very good but still very optimistic on the timeframe. Things are going at an exponential speed, and we are discovering every year that our provisions were too conservative.

So it comes to a basic point, what will these men and women do? They have to be able to learn all the time. We have, to answer your question, to learn all the time, to be able to invent. If we want to refuse or to slow down the arrival of the robots, we will be outcompeted in all the world markets. That is what is happening in Detroit, in Pittsburgh, in France. The steel industry, the automobile industry are tumbling because we have been fearful of the automation, and we cannot continue that way; it is only the way to bankruptcy.

So we have to accept and even perhaps to accelerate the automation of our productive system on the obvious fundamental condition, but before we do that, or parallel with doing that, we teach, we are able to teach people how to learn for their capacities to give them new, superior jobs.

So this is a question that is addressing all of our countries, and complicated, to a very great dimension, by the fact that we must find means by which we make people capable of learning all the time. In this house of Congress, as in the far-fetched places in Africa, this is the scope of the challenge. Our fundamental faith and belief is that this can be done.

Mr. GORE. Well, it does need to be done in this place in Congress. We have sponsored a computer literacy course for Members of Congress that took place yesterday and Monday and will take place tomorrow, where Members of the House and Senate come and try to learn the basics of personal computing. There has been an excited reaction to this. People have learned a great deal from it.

You know, perhaps it is unfair to ask you and your colleagues to flesh out in detail what the new give and take would look like. I fear, however, that the attractiveness of your ideas, your vision, in the United States will depend to some extent upon your ability, our ability, those who believe that we must make such an initiative, to spell out what goals we are aiming toward.

One can share your vision and, nevertheless, have difficulty convincing citizens of this country that the United States should participate in such an effort, unless we are able to tell them what is it we are heading toward.

Let's suppose for a moment that a center was established in the United States.

Mr. SERVAN-SCHREIBER. Or many centers.

Mr. GORE. Or several centers in the United States and in Japan and elsewhere in Europe. And let's suppose you could look into the future to the year 2000 and make the assumptions that other nations in the world created such centers and concentrated on applying informatics to solve problems in the Third World.

What would such a world economy look like, and what would the major imports and exports be?

Mr. SERVAN-SCHREIBER. Very briefly, and I will ask my colleagues to answer your question, first of all, Mr. Chairman, I think we should forget about the year 2000 completely. It has become a habit in the public debate in my country and in others to think about the year 2000. This is far, far too late. Things must happen in this decade, and you see it in this country. The crisis is deepening.

To take only two signals, in this year, 1982, and not in the year 2000, the whole industrial world will be, this year, for the first time, at a zero growth in industrial activity. Zero growth is the OECD development prediction and confirmed by other information for this year. Now, this means immense problems to solve.

Second, among, let's say, the 140 countries of the Third World, half of them, by the end of this year, not the year 2000, will default on their debts.

Take these two facts. On our growth, which has become zero, on the ghastly debt of the Third World which will prevent them from even paying the interest on their debt again this year, we do not have the time to wait.

So this means what? We have to invest fast, and the only way to do that is to invent in common. If there were any time when nationalism, isolationism, protectionism were meaning suicide, it is now. If we have a chance to face this crisis and master it, it is by doing it in common, totally in common.

We are not afraid, and I am sure you are not afraid, of the Japanese. We want to work with them. We are not afraid of the Americans; we are proving it. We want the Americans, most of them, the best of them, to work with us and us to work with them. The Third World should be not only someone with whom we will talk later when we have the answers; they must be at the same table formulating the questions, formulating the answers. The era of mental colonialism is absolutely finished. If we want to sell them packages of hardware and software, they will refuse it immediately. They must be able to conceive it themselves.

These are simple things, not conventional with the past, but if we formulate them and study them together as you have invited us to do today, but repeatedly and then continuously, we can have a real chance.

To finish on this, you said center or centers in the United, States. Yes, sir, we envisage many centers of this kind in the United States, let's say several. We are already working regularly, which means almost every day, with very great centers of intellectual invention in these fields, especially computer science and other sciences, and with MIT, with Carnegie-Mellon, with Stanford. This network would enlarge. The United States has a crucial responsibility because at this time in the world everybody recognizes it.

When I was in Japan 3 weeks ago, they also do recognize it. The greatest inventors, the greatest fountains of this science, are still, by and large, American. The people who do not seem to realize it, if I may say so, are the American people. They have the treasure. They are not using it. Other countries are using it. So we want America to accept the challenge and use its own treasure, its own knowledge, and if we can help that, we will help the world, not only America.

Then a network of global centers will develop, not only in these rich countries. Already today, in Senegal, a center is developing; in the Gulf of Arabia, in other countries in Latin America and Southeast Asia, and these will develop very fast, in the course of the next 2 or 3 years, and working together on a daily basis, an instantaneous basis, with all the new means of telecommunications and transfer of information.

So this will lead us rapidly to a unified world scientific and inventive community making progress the mention of which we cannot even imagine today.

Mr. GORE. Professor Reddy, as one of the world's leading experts on robotics, I am sure you have given a lot of thought to the implications of robotics for employment. What do you see replacing those jobs?

First of all, do you agree with the assessment of Business Week magazine, or do you think that it is too conservative?

Second, what do you think will replace these jobs?

Mr. REDDY. I think that is the challenge that we face, of understanding and developing the new job skills for the people of this country and also for the world.

There is, I think, a mythology that somehow robots are going to create unemployment. Almost all studies that I know of just show the opposite. The countries that do use automation and robotics, in general, have had greater employment than countries that do not because they are able to create more wealth through improved productivity and therefore can in fact create more jobs.

However, what will happen is there will be a shift in the job skills required. We do not have the time, as Mr. Servan-Schreiber mentioned, of the luxury of 50 years or 100 years as in the past to deal with the shifts in job skills required. We have to deal with them now, and soon.

I do not think we need to be worried about overproduction. In fact, there is industrial capacity in this country lying idle, the world is full of people that do not have anywhere close to our

standard of living. So if in fact we bring up the other 80 percent of the world to the same standard of living that we have, I think the industrial capacities of the world that we now have will not be adequate.

So coming back to your question about what areas the jobs will be in, I think the main area that we see the jobs will be in is the information industry. The second area is in the area of trading with the Third World. The third area is in the area of dealing with what you might call unessential areas for survival, like space exploration, like investing in the arts, music, and literature. These are not necessary for day-to-day survival, but a good indication of the standard of living of a society is whether you have a symphony in your city, whether you have a museum, an art gallery, and I think there are reasons to believe people can effectively devote their energies in all of these areas.

The last area for potential new jobs is in the area of service industry.

Mr. GORE. Mr. Servan-Schreiber, how would you expect corporate interests like IBM, for example, to react to a network of centers in the United States? Would they respond negatively or positively?

Mr. SERVAN-SCHREIBER. First of all, with your permission, I will not name any special company.

Mr. GORE. All right.

Mr. SERVAN-SCHREIBER. I don't want to make unnecessary enemies and, also, I am no judge on this field.

But I would make, if I may, a specific criticism of the whole electronics industry, by and large, in America and in Europe and in Japan. They have been so successful, by and large, in developing their products—large systems, office computers, et cetera, expensive, very useful—that they have not taken, until now, seriously the personal needs for computation.

You can read in the American or the European papers or the Japanese papers every day comments and discussions about personal computers that are made by that and that company. All of that is not true. There is no personal computer. They are all office computers, expensive computers, and there is none that you can really, in all fairness, ask the population of a rich country like America to buy for their children or to buy for their class. They are much too expensive, much too complicated, and there is no personal computer.

Now, I am totally sure my colleagues are much more competent to answer this, but it is obvious that if industry had been mobilized to develop the personal computer—that is one of our missions now—it would have done so. But it was making such easy money on other computers that they did not care for it. So one of our missions is to stimulate the industry, not only in America but in Europe and in Japan, to go very fast toward a real personal computer, millions and tens of millions of them, for a world of computation at the disposal of every human being with no special capacity in mathematics or physics or science.

That is what my friend and colleague, Professor Negroponte, calls the human interface, the friendly interface with the computer that he has described at the beginning of our adventure, in the first meeting in March, that should become as easy as a dialog be-

tween human beings. This is not for the year 2000; this is now that we should develop that. It is the only way to make people much more powerful with their minds and their creativity than they have been as laborers in industry.

Mr. GORE. Thank you very much.

I would like to call on Mr. Shamansky from Ohio, home of the Battelle Institute.

Mr. SHAMANSKY. Thank you, Mr. Chairman.

I feel honored to have such a distinguished panel of witnesses. I have read Dr. Pisar's book on coexistence and commerce. It is a very impressive book.

My nephew happens to be at Carnegie-Mellon, and I went through the Robotics Institute recently when a panel of our committee was in Pittsburgh for a hearing.

I would like to ask Dr. Negroponte and Dr. Papert about the brain drain which seems to be going in the reverse direction from that we usually think of it as going, namely from other countries to the United States.

The chauvinist in me deplores the idea that the National Science Foundation is not claiming your full time as distinguished from the World Computer Center in Paris. There is nothing wrong with it, I mean it is a lovely place to be, but can you explain, in your opinion, at least, the funding decisions of the National Science Foundation, and did they have any influence on your decision to become associated with this, and was this a concept that, in your opinion, should we have worked on first?

Mr. NEGROPONTE. I had long ago given up trying to get funding from the National Science Foundation, so that bears no relation on my recent decision to move to Paris.

Mr. SHAMANSKY. In other words, your despair took place a long time ago?

Mr. NEGROPONTE. A long time ago.

Mr. SHAMANSKY. I see.

Mr. NEGROPONTE. I think the National Science Foundation gives money away in small chunks, pays attention to geographic distribution, and the peer review system is not a successful one. So I have found it a source that was just unavailable to me. One of the reasons that the Paris operation is very attractive is it has scale, it has size. We are too accustomed to funding, particularly through the National Science Foundation, small projects.

I don't know the correct form, but if it is possible, I would just like to go back to Congressman Gore's question to Mr. Servan-Schreiber two moments ago about American industry and, just for the record, insert two names, namely, Digital Equipment Corp. did respond, Congressman Gore, by giving the World Center an enormous gift very recently, namely the largest machine they make as a telecommunications node for the World Center.

Mr. SERVAN-SCHREIBER. Last week.

Mr. NEGROPONTE. Last week it arrived.

Apple Computer has given untold numbers of machines which are almost going to be over 100 and move into the thousands, we hope, very shortly. American industry has been exceptionally generous, and I am sorry to go back one comment.

Mr. SHAMANSKY. No; it is appropriate. This is what I am trying to find out. Now, were they ever asked to give anything to an American center, or would you know?

Mr. NEGROPONTE. Of course, they are, and American industry is constantly asked to support private universities. I, by chance, have spent a great deal of my past 2 years trying to get funding through industry. I have to say that we are in a very obvious situation where it makes it difficult for people to give money, so it is hard for them to give money. The new tax laws make it a little bit easier to give equipment. So, perhaps the generosity that I am referring to right now is a coincidence of manufacturing and the ability to give equipment versus money.

Mr. SHAMANSKY. I mean, American charity, as a matter of public policy, has been to channel charitable gifts by use of the tax laws. I mean, that is something that is accepted and understood.

Mr. NEGROPONTE. Absolutely.

Mr. SHAMANSKY. In your experience, was such a center ever contemplated for this country?

Mr. PAPERT. I would like to pick up that and, first of all, say about the National Science Foundation something paradoxical about its role in the development of the kind of thinking that is represented by the center.

Unlike my Professor Negroponte, my own work has been in fact largely supported through the National Science Foundation, and as I have always understood it, there has been a group of people in the Science Education Directorate who have shown enormous imagination and have struggled to do what they can within a restricted system to support a number of projects that have in fact contributed enormously, in my view, to the position where that has made possible the existence of the center.

I think the center could not have happened scientifically but for projects that were supported by the National Science Foundation. It is extremely paradoxical that that part of the National Science Foundation has just recently been slashed to pretty well nonexistence. I suppose you are in a better position than I am to think through why that should have happened.

Mr. SHAMANSKY. No, Professor Papert. I do want you to understand that I have not the slightest idea. It has been a source of great discomfort for me because I cannot comprehend it, myself.

Mr. PAPERT. Indeed. But I think this is a fact that future historians of knowledge and of maybe, if I am right about the importance of the politics of learning—you were not here, I am afraid—I think this is something that people will ponder for a long time, perhaps. It is, I would say, pretty nearly suicidal——

Mr. SHAMANSKY. It is calling eating the seed corn around here.

Mr. PAPERT [continuing]. What the United States has been doing in the area of mobilizing intellectual resources for the development of new approaches to learning and education, particularly mobilizing the new technologies. It really is paradoxical that just at the point where, for the first time in history, we have the material technological infrastructure for really approaching the problem of learning in a fundamentally different way, for the first time, the United States should decide to slash back at that part of its fund-

ing organization that has most contributed to what has been done in the past in that area.

On your other question about whether something of this sort has been contemplated in the United States, of course, nothing quite of this sort has been contemplated at all. The conceptualization of the center came about through the merging of a number of streams of thinking and took a form that perhaps only could happen inside the total social and intellectual atmosphere of France.

But that is not the fundamental way of approaching your question. The more fundamental way is that, indeed, the idea that there should be centers of excellence and research devoted to exploring those ways in which information technology and computer science can articulate with the improvement of learning and human mental activity, such ideas have indeed been present in the United States.

Mr. SHAMANSKY. Thank you.

Mr. PAPERT. I have personally tried to sponsor and get support. There has not been a forthcoming response from the funding organizations of this country.

Mr. SHAMANSKY. Thank you.

Mr. Servan-Schreiber, if I may ask, when you took on this job, did you, or do you, contemplate other centers being established? In other words, in your opinion, is there room or do you desire more? In other words, do you see yourself as an example—I don't mean you personally—but the center as an example to be emulated by other countries?

Mr. SERVAN-SCHREIBER. Yes; and very clearly. Our plan is very clear and very simple. We want the center to be powerful and, as was mentioned, a center of excellence, first in human brains, the best possible scientists in computer science and human sciences, to find a way to channel the exponential power of microcomputer science toward human learning; and also a center of excellence in equipment; that is why it was appropriate that Professor Negroponte mentioned the generosity and intelligence of some American companies who understood that and helped us to have the best possible equipment.

I must mention, in the same vein, that when I was in Japan on the official visit there, for a full week, of President Mitterand last month, the company, Nippon Electric, that makes, for the moment, the best and possibly the only machine in the very crucial field of speech recognition, has given France and the World Center two machines, DP 200 speech recognition machines, that are now at work at the World Center.

So, we want our center to be as rapidly successful, meaning powerful, as possible. It is open all the time. When we started with Professor Negroponte, the rule that we decided and that we are trying to implement very fast is that this center will be a real one only if it is open 7 days a week and 24 hours a day and open to anyone who wants to try for himself to learn how to learn with these computers and these sciences, and we are rapidly going toward that.

Saturday, Sunday, just before we came to you, all kinds of people, young and old, were there—it is very close to the Elysee

Palace, very close to the Champs Elysees—coming in and finding it so fascinating. As you know in America, they stay hours and hours.

Now, this summer, in June, I am invited, next month, in California, to a seminar of 40 presidents of universities that have decided to go as fast as possible to the personal computation field, meaning to the total computeratization of their campus, meaning one computer per student. Now, this is a fundamental development.

We have seen, in the course of last year, in my campaign in America with all kinds of debates around the book, the world challenge that Dr. Pisar was mentioning coming out of our experience with the Paris group; I found great skepticism in America a year ago, and that is when Professor Papert, leading his crusade, also found so many difficulties.

In the course of 1 year, America has already evolved a lot. If we can help that movement, it is a crucial thing, and we will. Nobody can contemplate a global plan for elevating the degree of learning of the world and so finding the only solution out of the crisis without America's intimate and powerful cooperation.

Now, other centers are starting, also, elsewhere. America should help them, and we should help America. There is no question of nationality involved any more. It is really a world movement.

Mr. SHAMANSKY. Could you tell us, if you have it available, the capital investment that the French Government is making in this. We have here in the story from the Washington Post a $20 million annual budget, but that is an operating budget. What is the capital investment?

Mr. SERVAN-SCHREIBER. For the equipment, you mean?

Mr. SHAMANSKY. Well, I mean for the building and whatever the initial investment would be.

Mr. SERVAN-SCHREIBER. We have a building that you are invited to visit because it is a nice one, 4 minutes from the Elysee, 3 minutes from the Champs Elysees——

Mr. SHAMANSKY. I am sold already. I can't wait to go. [Laughter.]

Mr. SERVAN-SCHREIBER. And it is very modern and operational, and we have the necessary equipment. We are inside our first budget for the first year. We do not need immense machines. We are very happy to have this DEC machine that will be the technological heart of the center. As you said, the budget that I proposed to the French President that was accepted is 100 million francs a year, $15 million to $20 million, and this is the basis of our start.

We are going to enlarge that to international funding. It should not remain a purely French operation. These centers should be widely diversified in their funding for one reason, sir, for one fundamental reason, apart from the calculation of the funds. It is that the scientists should be totally free of their choices, of their strategic decisions with me and with the board, and they should not be obedient to any State bureacracy or any national specific interests.

So, to free the scientists for their own decisions, we must diversify the funding, and all these centers will have diversified funding.

Mr. SHAMANSKY. So, there is no thought of retaining some kind of secret edge over somebody else in this area of science and technology?

Mr. SERVAN-SCHREIBER. That would be exactly opposite to the whole philosophy of the center.

Mr. SHAMANSKY. That differs significantly from some of the testimony we receive from certain of our own Government officials.

Mr. SERVAN-SCHREIBER. The same thing in every country.

Mr. SHAMANSKY. Well, good. That is reassuring. Thank you. [Laughter.]

Dr. Pisar, if I may ask, I know you are a specialist in East-West trade and have advised many companies internationally who deal with the Soviet Union.

Based on your general information, is there a comparable center in the Soviet Union?

Dr. PISAR. Based on my information, sir, there is nothing comparable in the Soviet Union. In fact, the Soviet Union is one of the most retarded countries in the area of computer sciences and the whole application of that science to industry and technology.

You may remember—and you were generous enough to mention "Coexistence and Commerce"—in the introduction to that book, I quote Andrei Sakharov, long before he won his Nobel Prize and acquired such an extraordinary dimension in the sphere of human rights. Andrei Sakharov, in a letter addressed to President Brezhnev and Prime Minister Kosygin at the time, warned the Soviet Union that the Soviet Union was falling more and more behind not only the United States but most industrialized countries, and he said, literally, that in the vital, crucial area for the future, computer knowhow, the Soviet Union was at least 10 years behind.

Of course, what he had proposed—and this is why I mention it, because it is all related—is that even if the Soviet Union were to join the feast of industrial and technological development, it would have to reform; it would have to allow more human freedom.

We are dealing here with a very, very basic thing. I am of the fundamental conviction that one of the reasons the Soviet Union is so far behind in this area, as in many others, with the exception of military know-how and technology, is because minds are not allowed to clash. New ideas are not allowed to percolate, and there can be no sustained economic progress unless minds are free, so that the Soviet Union is now reaping the bitter fruit of its technological backwardness in agriculture, where it cannot feed its people; in its civil industry, where it cannot produce products that the world market can absorb; in the sustained and uniform development of technology. Everything is concentrated in the military field.

Mr. SHAMANSKY. If I may, I would like to comment. I was unable to be here at the beginning of this hearing because I went to a classified briefing by the Department of Defense of some Members of Congress on the Soviet military buildup. I saw pictures of the *Kirov* class battleship or cruiser, battle cruiser; their new submarines, which are 562 feet long, something like that; their new battle tanks, the T-80, I think, one of them, T-64, T-72; all with the latest whatever in destruction.

Are they able to maintain that kind of military development? How can they maintain that kind of military effort without having the infrastructure, technologically and scientifically, to produce these things that nobody can eat, of course, or live in, but yet they are doing it? Would you care to comment on that?

Dr. PISAR. Well, I regret in a way, sir, that the other hearings did not adjourn to join these ones because we could have broadened the scope of our discussion.

Mr. SHAMANSKY. I think the juxtaposition is fascinating.

Dr. PISAR. I believe that the Soviet Union cannot sustain this type of investment in armament technology and, at the same time, do the minimum that is necessary for the welfare of its people.

Now, I may shock you by saying that I am not at all certain that our country can afford forever this tremendous battle on two fronts of squandering, necessary and important as it may be to maintain a balance of power, endlessly the best brains and the best resources on this fantastic investment in arms that we hope will never be used; nor other countries.

It is just impossible to try to meet these two challenges of military security and human welfare. We are moving toward a situation where the two super powers, far from having a balance of strength, are developing a balance of weakness, paralyzing one another, bleeding one another white while the rest of the world is becoming desperate and chaotic and miserable.

Mr. SHAMANSKY. What I am reacting to is, as wealthy as we are, we are not unaware of the cost. The Soviet economy in general is significantly poorer than the United States, but the military effort is simply staggering.

Dr. PISAR. It is staggering, and if you are asking him how can they make it, how can they manage——

Mr. SHAMANSKY. Yes, I am asking you that.

Dr. PISAR. I will attempt to give you an answer. I have come to the conclusion a long time ago that in the Soviet Union there is no national debate along the lines of guns or butter. The Soviet Union is a country that has been through many violent halocausts in its history. It has been invaded over and over again from the East and from the West—the Mongols with Genghis Kahn, the Teutonic knights, the Polish barons, Napoleon, Hitler.

The Soviet Union, on the one hand, has a doctrine according to which it would like to dominate the world, and I think the wiser minds have realized that that doctrine today is sterile; that it does not lead anywhere; that it is no longer a model for the young people either in the Soviet Union or in other parts of the world; and that it is not worth taking the risk of a thermonuclear holocaust to try to impose that doctrine in a military way on the rest of the world.

You have many people in the Soviet Union who have a historic memory of suffering and bloodshed and invasions and who follow that slogan that many Jewish people who have been through a holocaust also follow: "Never again."

This historic fear, amply justified by the Soviet historical experience, enables these longsuffering Russian masses to accept long periods of privation, of poverty, in order to insure and to control the fear that they might be one day invaded again as they have been in recent memory, and this is what enables those leaders to put the emphasis on the military budget.

Mr. SHAMANSKY. Dr. Pisar, with apologies to Mr. Servan-Schreiber, it reminds me of what was said about the Bourbons of France: They never learned anything and they never forgot any-

thing. I mean, it seems to me that is what you are saying about the Russians.

Dr. PISAR. I think that this is one of the key aspects of the problem that allows the Soviet leaders to squander these enormous resources on arms while the people still live largely in misery.

Mr. SHAMANSKY. But with respect to the more narrow thing—and I am sorry to have gotten off, but I thought it was somewhat related, in my mind at least—with respect to the computer world center, you see nothing in Eastern Europe that would indicate——

Dr. PISAR. I see nothing in Eastern Europe. I think that they are very far behind. I see manifestations of Soviet interest in certain international institutions that are concerned with computer systems and the like. For example, there is that institution in Vienna, YASA, that consists of a number of countries, and that institution is, at the present time, presided by a Soviet personality, a German vitiante who is also the deputy chairman of the Soviet State Committee of Science and Technology, ministerial rank, and that man, I would say, almost singlehandedly has been pushing the Kremlin and the Soviet Union to pay much more interest to the sphere of computer sciences.

I think that this is an area where the Soviet Union is inexorably losing the race. They may or may not be doing well in the military area, but this is certainly an area, from whatever I know personally, where they are losing out and where they are losing the future.

Mr. SHAMANSKY. Thank you very much.

Professor Ayensu, I have been to Accra, and I would like to ask you one or two questions about the network of African scientists. Will you be setting up in Africa a branch or a sister group organization to relate to the World Computer Center in Paris?

Mr. AYENSU. I think it has already begun. When the program started, as Mr. Servan-Schreiber mentioned, it was started with the idea of incorporating both the developed world and the developing country technologies.

I guess Senegal has already started a project, and we are hoping that this will be duplicated not only in Africa but in Latin America and in Asia. I think it is going to happen because I have a very firm belief that the people are ready to participate.

Mr. SHAMANSKY. Is there any problem—you mentioned Senegal, which is French speaking, and of course Ghana is English speaking. Is there any problem about the split between English speaking and French speaking in this particular area?

Mr. AYENSU. Well, to give you an example of the bridge that we are trying to establish, last April the French Government and the United Nations environmental program, UNESCO, and the International Council of Scientific Unions put together a package that made it possible for us to inaugurate the African Biosciences Network.

To my utter surprise, a lot of my Francophone Africans do very well in English; in fact, they do much, much better than the Anglophones do with French. But it is really not a difficulty because we manage to have bilingual translations. As far as the scientific literature goes, I do not think it is a problem at all.

Mr. SHAMANSKY. So, you do contemplate effective cooperation among the African States?

Mr. AYENSU. Absolutely.

Mr. SHAMANSKY. Thank you, Mr. Chairman.

Mr. GORE. I will come back to you, Mr. Shamansky. I want to recognize Congressman Volkmer of Missouri.

Mr. VOLKMER. I am sorry, too, that I could not be here for the full testimony.

I would like to ask, where do you find at the present—anyone on the panel that wishes to answer—the advancements are the most rapid advancements at the present time in the use of computers for engineering and industry, whether it is robotics or whatever it is? Where do you find that at the present time?

Mr. REDDY. Perhaps the most exciting advances are coming from marrying computers with communications.

Mr. VOLKMER. All right.

Mr. REDDY. This makes it possible for anyone, even in the remotest village in the middle of Africa or India, to have access to the knowledge of the world.

A second issue that relates to that is the development of amorphous solar cell technology which, I am told, currently is being produced in five factories by Sanyo in Japan. We do not have that technology here except in laboratories. It is claimed to cost about one-fifth of what the conventional power sources cost. This makes it possible to have computer-related electronic technologies in any remote village without the large infrastructure that one would need to make effective use of computers in villages.

Mr. VOLKMER. In other words, you would be able to use it at any place in the world, then——

Mr. REDDY. Any place in the world.

Mr. VOLKMER [continuing]. Even though you do not have a power supply or anything.

Mr. REDDY. Exactly. And the third area that is in fact exciting, advances that are happening, is in fact introducing robust, fall-tolerant, supercomputer-type technologies in a shoebox.

Mr. VOLKMER. In other words, the compactness of it.

Mr. REDDY. You see, as computers get faster, they also get smaller.

Mr. VOLKMER. Yes.

Mr. REDDY. And we are now talking about supercomputers in a shoebox the size of a transistor radio. The single most important group that is helping to develop these ideas and concepts is DARPA, Defense Advanced Research Projects Agency, of the IPT office.

I think, between all of these, there is a major confluence of all these ideas, and together they will make possible the dream that Dr. Servan-Schreiber and Dr. Pisar have initiated and got us all excited about.

Mr. VOLKMER. In other words, basically, what we are talking about, then, is an ability to obtain knowledge. Is that correct?

Mr. REDDY. I beg your pardon?

Mr. VOLKMER. What you are talking about now is the ability to transfer knowledge or obtain knowledge.

Mr. REDDY. Yes.

Mr. VOLKMER. Utilize that. Now, you have the knowledge. Now, I am seeing, also, as I read a little bi , you are concerned, also,

about, in the future, whether it is the year 2000 or when, as we no longer use the type of factories that we are using, no longer use the type of plants and the personnel, what do we do with the people? When do you anticipate that you will be able to come up with any answers as to how do we utilize people that are no longer necessary in industry, et cetera?

Mr. REDDY. I think the key thing was answered earlier, but let me repeat in a slightly different way. The issue is not technology transfer; it is the knowledge transfer, making available the knowledge of the world to every individual in the world. And in that sense——

Mr. VOLKMER. All right, but knowledge without utilization of knowledge does not bring you an inch.

Mr. REDDY. I think that is exactly where we can learn a major lesson from Japan. At the end of the second world war, essentially, the industrial capacity of Japan was destroyed; there were other countries at the same time that were just becoming independent, like India.

Now, after 30 years, let us look at the two situations. It is the knowledge that matters, the skill levels and the knowledge of the individuals, not the money, not the raw materials, not any of the other things. That is why the development of the human resource is perhaps the single most important thing in the world.

It is not the labor value theory of Marx and others that is important; it is the knowledge value theory. It is the level of the knowledge and the skill levels of the people in the country that makes for the wealth of the country.

If you can in fact infuse the whole world with that knowledge, then you can raise the standard of living of everybody to that level. This is why the whole issue of learning to learn, knowledge transfers, technologies where the knowledge is available anywhere in the world become extremely important scientific and technological issues.

Mr. VOLKMER. But let me ask you this question that just came to my mind. If the knowledge is available to everyone and everyone has, basically, the same skills, but somebody else has the resources, and 2,000 miles away you don't have those resources, doesn't that put the persons at advantage who have the resources as against those that don't, everything else being equal?

Mr. REDDY. Yes; in fact, the people that have the knowledge and the resources will in fact benefit more than those that do not. Unfortunately, most of the resources are not on the land. They are either in the oceans or in space.

One of the countries that is leading again in that technology is the United States. Already we have been talking about space manufacturing and space exploitation, and there is a major program at the Office of Naval Research on underwater exploration and exploitation of the ocean resources.

So in some sense, those resources do not belong to any country, any single individual. So I do not think we will have this problem of disparities of the haves and the have-nots, except in the case of knowledge.

Mr. VOLKMER. All right.

Now, I would like to go back one point, Mr. Chairman, and that is, you mentioned that Japan has made a breakthrough in a solar cell.

Mr. REDDY. Yes.

Mr. VOLKMER. Do you have any idea about what we are talking about if we relate that to here as far as costs in generation of electricity?

Mr. REDDY. Yes; the current cost of using solar cells is about a factor of 10 more expensive than the conventional sources of energy.

Mr. VOLKMER. Yes; what are we talking about as far as their new breakthrough?

Mr. REDDY. Normally, it is estimated it costs about $1.20 per watt in capital investment. Current crystal and solar cell technology costs about $12. The new technology, the amorphous solar cell technology, it is estimated will cost 30 cents per watt in capital investment. So it is a factor of 5 more effective if the sun is shining. Otherwise, you know, it is not much good.

Mr. VOLKMER. Thank you very much.

Thank you, Mr. Chairman.

Mr. GORE. Yes.

Mr. Shamansky.

Mr. SHAMANSKY. Thank you, Mr. Chairman.

Mr. Servan-Schreiber, in my home community of Columbus, Ohio, we have the Chemical Abstract Service of the American Chemical Society, which collates and distributes everything to do with what I will call the non-Soviet bloc science with respect to chemistry. I guess it also gets information from the Soviet Union as well.

An important issue for them is the transborder data flow and possible blockages of that—obstacles, nontariff barriers, or even tariff barriers. Would you care to comment on whether or not your center, which seems so open, has given some thought to the whole question of transborder data flow? I think you understand what I mean, the transmission around the world instantaneously.

We have a commercial on television of ITT or AT&T connecting to Paris and getting some information back and forth. Would you care to comment on this problem?

Mr. SERVAN-SCHREIBER. I would care, sir, and perhaps very briefly elevate our debate to what is so fundamental in this country, and for legitimate reason.

Dr. Pisar was discussing the duel that is fought daily all over the world between American and Soviet Russia with two so different conflicting philosophies. If we do not clarify our thinking, all of us together, on this, as you have proven yourself this morning, then the total mental energy of our countries, of our parliaments, of our political leadership, will be stolen from any kind of progress by the obsession with military hardware and the permanent conflict between these two worlds.

Now, what we are discussing this morning seems to me, to answer your question related to that, very linked to this abysmal problem of eternal funding of a potential nuclear war between America and Russia.

Nobody can, and nobody does, think for a moment that the Soviet system will ever be destroyed by nuclear weapons. What has appeared now is that what you have been mentioning, the immense power of personal computation for freeing the individual, his own mind, his own capacity, his own job, his own life, from any kind of bureaucracy, state bureaucracy in particular, is a revolutionary instrument for winning freedom and peace.

Mr. SHAMANSKY. But could it not also be used as an instrument to oppress people even more thoroughly?

Mr. SERVAN-SCHREIBER. Yes, but I am not a candid optimist. This technological revolution we are discussing this morning can lead us into an abysmally bad world if the power of computation and this industry and science is concentrated in a few hands by a few big systems, then the Communist system, whatever its name will be, will have won.

The state, the big organizations, will have become forever, because of the power of this new science, the masters of the individuals. This can very well happen. I am not making any prophecy.

But there is another road that is open in front of us, and it is our decision to choose this road or not. It is the personal way. It is to put all this power by the telecommunications system all over the world and by the capacity of personal computation at the disposal of the individual. That would free himself from any teacher, from any master, from any state.

Mr. SHAMANSKY. What is the policy of the Common Market for the OECD?

Mr. SERVAN-SCHREIBER. To lead to that. This would be the victory of freedom once and for all against the bureaucracy and dictatorships. So this is a very major choice. It must be very clearly put in front of our populations, of our societies, of our political leadership, and this is very urgent.

Mr. SHAMANSKY. But look at the problems we have in the Common Market with a common agricultural policy, where nationalisms, it seems to me, intrude in the effective use of resources. Are you hopeful of overcoming those nationalisms even within the Common Market?

Mr. SERVAN-SCHREIBER. Yes, sir. We follow that every day in Europe. It is a very outmoded debate because, you know, our political leadership, and many of them are friends of mine—I have no reason at all to criticize anyone—all of that is very difficult and complicated, and the schedules are tremendously difficult for everyone.

But this debate on the common agricultural market is very obsolete because the people who are debating there have not yet found the time to study this new human resource that will change totally the equation of the agricultural market, as of the industrial market.

Now, you were speaking also of the flow of data across borders. This is crucial to the rivalry between the democracies of the world and the dictatorships of the world. We do not have to prepare for war because we are incapable of starting a war, thank God. So the only crusade—not war—we are capable of starting and winning, not for us but for the world, is to free the individual, to do away

with the borders, to do those new technologies, not by taking away flags or borders.

Mr. SHAMANSKY. But in fact, what is happening in Europe? Are there barriers to the free flow of information just within the European Community itself?

Mr. SERVAN-SCHREIBER. Less and less, and soon it will be totally impossible. With the satellites and the networks, it will be even impossible for any nation of Europe to control its own television. It will be free flow of television because nobody will prevent, from the sky, the television networks from taking a program that they want.

Mr. SHAMANSKY. How about between Europe and North America?

Mr. SERVAN-SCHREIBER. I do not see any conceivable good barrier between Europe and America. Any barrier is bad, and so what you see today in the Common Market, in the ideal, should very soon enlarge to North America, of course, and to Japan and to the rest of the world progressively.

Now, what I would like to ask you is, since Versailles, not because it is Versailles but because it is a very important moment this year, in 1982, will these leaders go into the routine, hopeless, sterile, of these summits, that will never come with any kind of concrete answer, or will they focus on the one thing that can really help the whole world out of the crisis, which is the transfer of knowledge?

We have the means to do it if we concentrate on how to do that together and put all the resources in the right order of priority. Now, you in Washington can help a lot by convincing your representatives to that summit that this is at the top of the agenda, and the greatest interest of the United States is to take the leadership of this.

Mr. SHAMANSKY. Mr. Servan-Schreiber, I wish to assure you, I keep offering my advice, and they don't seem to call frequently for it. [Laughter.]

But that is just a practical matter.

Thank you, Mr. Chairman.

Mr. GORE. Let me ask you about the funding of the center itself. Do you presently have any contractual relationships with commercial companies?

Mr. SERVAN-SCHREIBER. No.

Mr. GORE. Are there companies in France that enter into your future plans?

Mr. SERVAN-SCHREIBER. In what sense?

Mr. GORE. In the sense of providing funding in the future.

Mr. SERVAN-SCHREIBER. From companies?

Mr. GORE. Yes.

Mr. SERVAN-SCHREIBER. Oh, we could conceive, of course, contracts with any companies—French, American, Japanese. Our aim is to disseminate any kind of inventions that we could find with our work toward personal computation and to help all companies capable of manufacturing these new tools to do it as fast as possible. We want to deflect these very powerful companies from the obsession of the office market toward the personal market.

Mr. GORE. Are there any OPEC nations currently providing funds for your center?

Mr. SERVAN-SCHREIBER. No, but two OPEC nations, Kuwait and Saudi Arabia, through the friendly relationship that we have developed, as Dr. Pisar mentioned, in the course of the last 3 years, have taken very seriously these efforts and these breakthroughs, and they want experiences of this kind to be implemented in their countries. From that, they will devise lessons for the rest of the Third World, and most probably they will—it will be their decision—help with the funding, not especially of the World Center but of the network of centers around the world.

Mr. GORE. Let me take the project in Senegal which you mentioned as a case study, as a hypothetical case. Let's assume that at some juncture your educational goals, or the transfer of knowledge, have taken place, and the market for hardware increases in Senegal. I know these sound like mundane questions in light of the vision you have, but would it make any difference to you what country's goods start selling well there or elsewhere? It does not, does it?

Mr. SERVAN-SCHREIBER. It is not my decision; it is a Senegalese decision. It is not a colony any more. It is an independent country. Our duty is to transfer knowledge to Senegal, and we have started. What they want as hardware, as telecommunications, as networks, et cetera, is their decision. We are not binding the transfer of knowledge to any kind of commercial decision.

Mr. GORE. It would make sense, though, for them to buy the kind of hardware they were accustomed to, would it not?

Mr. SERVAN-SCHREIBER. But they are accustomed to no hardware.

Mr. GORE. No, I am saying after the process of education takes place, after you accomplish your initial goals of transferring knowledge to Senegal, and then they decide to exploit this to a greater extent. It would make sense for them to buy the equipment that they were used to.

Mr. SERVAN-SCHREIBER. It might. It is a fact, as Professor Negroponte pointed out at the beginning of our hearing, that the Apple Corp. has been very generous in helping us, and we have, of course, never refused—we took it with gratitude—in putting all kinds of computers, I mean many computers, at the disposal of the World Center itself, and it is a fact that in Senegal, where I am going, as I said, tomorrow, the first computers have been Apple computers. We are also putting French computers, and we do not refuse any kind of good computers. And then the Senegalese will do what they want.

Mr. GORE. I recently met with the head of that corporation, the Apple Corp., who was here in Washington pushing an idea of his to have computers placed in all American schools.

You might be interested that he has encountered some of the same suspicions or cynicisms, and I think he is quite sincere in seeing the great potential in this country to teach children how to use these computers, and yet his competitors and others say, Ah, you are just trying to create a market for Apple computers. It is interesting that he is providing equipment for your project.

Mr. SERVAN-SCHREIBER. That is his duty to create a market for Apple computers.

Mr. GORE. Yes.

Again focusing on Senegal, according to some experts, the major factor inhibiting the transfer of knowledge or the transfer of technology is the lack of an adequate infrastructure in the developing countries, and I would invite you, Mr. Ayensu, to respond to this, as well as other members of the panel.

Professor Reddy, you referred to the solar possibility as a means around the lack of electricity grids in parts of the world. But by using the word "infrastructure" I mean to convey much more than just an electricity grid.

This is a very serious obstacle in the path of your plan, as I am sure you are quite well aware, things like the educational infrastructure, the cultural traditions, and so forth. Would you all respond to this obstacle?

Mr. REDDY. We have been thinking about it, and the plans are not yet final or cast in concrete, but we can say a few words about the direction in which our thinking is going.

One view we have is somehow we have to begin to experiment in a number of places, perhaps as many as 500 villages throughout the world including the United States, where we might want to experiment with this infrastructure problem, where people do not know anything about computers, and you might provide them with a powerful personal computer and a projection TV and a video tape recorder and an Earth station.

The question is, how would this run? What kind of infrastructure is needed? How will they repair it? How will they provide energy for it? How will they use it?

There are a number of routine, mundane issues like survival, food, health, and agriculture, and so on, that are in fact the fundamental issues we are looking at.

On all of these, the basic scientific question we come back to is the knowledge transfer or technology transfer or skill transfer. How do you do that, and how do you create the body of knowledge that one can transfer when a person in the middle of a village has a problem?

I would like to defer to Professor Ayensu to talk about a few of these.

Mr. AYENSU. Mr. Chairman, I think your first question about infrastructure should really be addressed in a broader context. It is true that in most of the developing countries, particularly in Africa, the infrastructure that you have in mind is lacking in places.

But I venture to say that we do have a certain amount of infrastructure that is even much more compatible with the type of technologies we are talking about right now than the technologies of the 19th century and the early part of the 20th century.

I mean, why do we use cord telephones today? I think it is a very primitive way of hooking up communications, using cords and so on. At the time when we were using talking drums to communicate from one village to another, it was a totally cordless communication, wireless mode of information transfer.

I think the new technologies that are totally wireless are much more compatible with our sociology than you may actually believe. I strongly believe that the villages that we are talking about and the societies we are talking about are probably much better predis-

posed to a number of the new technologies we are talking about right now than you have in the industrialized societies.

So that is one point. I mean, I know that in your mind the first thing that comes in is dirty power, what we call dirty power.

Mr. GORE. What is that?

Mr. AYENSU. You go to Africa and immediately the electricity fluctuates.

Mr. REDDY. Power surges.

Mr. GORE. Oh, yes.

Mr. AYENSU. And obviously, you put important equipment in place, and you can really destroy it.

Mr. GORE. Yes.

Mr. AYENSU. I think efforts are being made right now to try to develop systems as big as a car battery to stabilize this.

Mr. GORE. Even it out, yes.

Mr. AYENSU. There are other technologies that are being worked out right now, and I have no doubt that probably in the next few years we should—well, I shouldn't say even years, in months—we may be able to see some of them in place.

Mr. GORE. But Professor Papert makes the point in his book—I see you chomping at the bit to respond to this. In your book, you make the point that cultural instability is an awesome obstacle to the ability to learn and to the ability to create the kind of self-image that enhances learning.

This ought to be part of our definition of infrastructure as well. Go ahead.

Mr. PAPERT. In fact, I would like to emphasize that aspect. If we think of making or designing computers for their compatibility with problems of development, one aspect of redesigning the computer is to make it more adaptable to the kind of energy available.

An important aspect is raised by Eddy Ayensu about making it compatible with people's sense of what is appropriate, like drums. A very important aspect is making it learnable. Some technologies have the quality like cars used to be in the United States. I think that was a very important contributing factor to the development of American knowhow and ability to solve tough problems, that so many people grew up at a time when automobiles and other technologies were transparent. You could open the engine; you could look inside. Fiddling with those technologies had a lot to do with the creation of the spirit of enterprise and problem-solving in many parts of America, not only in the cities, maybe especially not in the cities.

When we think about what kind of a technology is appropriate for Africa or anywhere else—this is true of America as well—we take into consideration whether that technology was designed to be learned, was designed to encourage the people who use it also to learn to fix it, to make it, to adapt it to other purposes, to use it as a model for thinking about problems that aren't directly related to it.

Right from the conception of our Senegalese project, where even elementary schoolchildren who are using computers, built into this project is a concept that this is a fixable machine, and one of the first things you learn about it is how to fix it when it breaks. It so happens—this is another one of those breakthroughs about the in-

formation technology—it so happens that this technology, like early automobiles, lends itself to teaching people to learn how to fix it as an integral part of learning how to use it.

That raises difficulties of a technical sort. We have to think through our design of the machines; we have to think through the design of the education programs so that everything meshes. But the concept is that we are not thinking about sending out a technology which will rely on support from without. Our model is rather, we are planting seeds inside there that will grow into autonomous support systems, and that is central to the whole planning of this program.

Mr. GORE. I see. You put, then, a great deal of hope; you are gambling quite a lot on the fact that those seeds will grow into autonomous support systems, because the lack of trained technicians, for example, to repair machines that breakdown means that there is nobody to fix them if they breakdown unless these seeds grow.

Mr. PAPERT. Well, I wouldn't say we are gambling. We are putting that at the center of our preoccupations in thinking through essential problems.

That is a technical problem, how to introduce the technology in such a way that people will learn how to fix it as well as to use it.

Mr. GORE. What about the lack of standardization among equipment? Do you see that as a problem?

Mr. PAPERT. It clearly is a source of problems, but I would exclude, personally, out of hand, any idea of imposing standardization. That seems to go diametrically against the concept of personal computation being something that can pop up in different forms all over the place.

Indeed, I think that, very central to the idea of the knowledge transfer to a place like Senegal or anywhere else is that we should encourage the development of Senegalese informatics and a Senegalese form of computers, so that the idea of standardization really goes against one of our fundamental intellectual commitments, that what we need to do is not to make one system that applies to everybody but to facilitate the emergence of many different forms in different places that are adapted to the conditions there.

Just a last point about gamble. It is not just our will and our intention that says it is not gambling, but we have noticed everywhere where computers have spread that there is a remarkable affinity between children and computers, and it is really staggering, an important piece of data, how easily very young children can move in this area to a level of competence that is totally staggering in terms of what you would expect from people that age.

I think what this says is that the time span needed to go from the situation in which there are not any competent technicians to a situation where there is an efficient and sufficient base of technical infrastructure might be much shorter in the case of this technology than in the case of any others.

Mr. GORE. We have discovered that affinity here in this city at an institution called the Capital Children's Museum, and the director is here with us today, and it is indeed a remarkable development. That exciting affinity is part of what you all are trying to tap and make spread around the world.

This committee has had a special interest in the United Nations Conference on Science and Technology and Development. They come at this problem from a different perspective. But do you find yourselves closely allied with the goals of forums like the UNCSTAD and UNESCO, or are there qualitative differences between your objectives and the various international initiatives such as the IPDC?

Mr. PAPERT. I would just like to mention one point that is not a difference in ultimate perspective but is a difference in strategy and that I think maybe raises some quite fundamental questions connected with centralization, standardization, the difference between what one might call a Soviet approach and a Democratic approach.

We are starting, in close collaboration with the Senegalese Government and other groups in Senegal, a project that is going to grow into something that has a big educational component in Senegal. There is a standard way of doing that, where you would spend several years developing the system, working it all out, and then you would go and deliver it, ready-made, on a large scale, to a large area.

We are taking a totally different approach. Half a dozen Senegalese were trained in use of computers, and they went back and they are working with 20 or so children on a tiny little scale. The strategy is for that little activity there to serve as the focus point for discussion out of which will come redesigning the system.

For example, something quite spectacular, I think, in terms of people's usual concept of software and how to develop it, those Senegalese children are working now with a French version of Apple Logo, which is a computer software system made over many years and with NSF support in the United States. We hope, within 6 months at the longest, that there will have been redesigned and implemented in Senegal a new system that has grown out of this and that will be implemented in a Senegalese language, Wolof. That is, within the first year of this project, we hope to replace the initial software and the initial program by a new round developed there in the culture, and this is the concept of planting the seed that will grow.

Mr. GORE. Yes.

Mr. PAPERT. In my opinion, if we want to see something big grow there that will really take roots, you have to start it small so that, at each stage, what exists is what can be personally appropriated by the culture, by the country, by the people.

And so, going back to the UNESCO and world organizations, obviously, our ultimate goals are very much in line, but I think that we are experimenting with a strategy that goes somewhat, maybe, at right angles to the approach usually adopted by international projects; that is, starting very small and letting it grow rather than planning and exporting and then hoping you can develop afterwards the expertise locally to keep it going.

Mr. GORE. I see. Well, that is fascinating.

I think it is interesting that the French are a leading supporter of the UNESCO international program for the development of communications. That is quite interesting.

Mr. Volkmer.

Mr. VOLKMER. Yes. I would just like to understand this whole concept just a little better because, I guess, unless you understand the scope of it completely, I don't understand what you are trying to do exactly throughout the future. I have heard general discussion of the concept of dissemination of information through the use of computers, and then I have heard the concept discussion on Senegal.

To try and put the two together, in the event, let's say, we are down the road 20 years, you would envision that the concept would be not only there but other places that you would have the computers in place.

Now, if I want to obtain information, would I be able to obtain information from any various sources or be able to obtain information only through a centralized source?

Mr. PAPERT. Are you talking about the information that we discover in the course of doing these projects?

Mr. VOLKMER. No; I am talking about general information and knowledge that someone discovers and wants to disseminate.

Mr. PAPERT. Right.

Mr. VOLKMER. All right, and I am in, let's say, to take a hypothetical, the country of Senegal, where we now have computers throughout the country and people are utilizing them, and here is some information.

Now, who determines whether or not that information gets to those people?

Mr. PAPERT. Oh, but I think that is exactly one of the central points about how the computer presence, married with modern communication technologies, makes possible a totally different way of thinking about how information would flow.

We imagine the whole world is in a network and that somebody sitting in a village in Senegal or wherever would be able to interrogate this network to the limit of his or her ability to learn to work such systems. And so there would be a tremendous incentive to learn to work such systems more and more.

Mr. VOLKMER. Are you envisioning that the local computer that the person has, whether it is in his home or business or otherwise, would be able to go in[illegible] or intercept signals that may be being transferred by——

Mr. PAPERT. Well, of course, not in such an accidental way. This village would have some kind of channel up to a satellite somewhere——

Mr. VOLKMER. That is what I am saying.

Mr. PAPERT [continuing]. And, through that, would have an access point into a worldwide network in which there are maybe millions of other nodes. In principle, any one of those could be interrogated. You just have to learn to find your way around this maze.

Mr. VOLKMER. In other words, if I wanted to find out information in the health field, let's say, then I could interrogate into that and obtain that information?

Mr. PAPERT. Absolutely.

Mr. VOLKMER. But where would I get it from?

Mr. SERVAN-SCHREIBER. Everywhere.

Mr. VOLKMER. That is what I am trying to find out. Where do I get it from?

Mr. SERVAN-SCHREIBER. Everywhere.

Mr. PAPERT. From everywhere.

Mr. SERVAN-SCHREIBER. All the data banks will be at your disposal, obviously; this is the whole concept.

Mr. VOLKMER. In other words, every data bank——

Mr. SERVAN-SCHREIBER. Nobody has the property of the data bank.

Mr. VOLKMER. Nobody would have property.

Mr. SERVAN-SCHREIBER. No. Nobody has property of the air that you are breathing.

Mr. VOLKMER. Yes; but if I do not disperse mine through that, my information, where it is a medical society or whether it is a medical clinic or whether it is a hospital association or whatever.

Mr. SERVAN-SCHREIBER. Obviously, sir, all the doctors should have total access to all the medical data banks. Who in the world would go against that?

Mr. GORE. Well, if the gentleman will yield briefly, we have copyright laws, and we have commercial data banks in the United States that you have to pay money to get access to.

Mr. VOLKMER. That is what I am trying to get to.

Mr. SERVAN-SCHREIBER. At this moment, yes.

Mr. VOLKMER. But you envision free access.

Mr. SERVAN-SCHREIBER. In the beginning, it is normal.

Mr. VOLKMER. Would you envision free access to such things as a patented material, whether it is chemicals or anything else? Would you envision free access to that?

Mr. PAPERT. Could I put it slightly differently? I think the important thing is not what any individual or any organization envisages. I think that the key point is this, that the presence of the computer in the world and its potentials put in question all the assumptions that have been made in the past about such questions as copyright and how to manage it. They won't work. One thing that is clear is that the notions we have had in the past will not work in the future.

I think that the right way to think about the kind of network we are talking about of individual computers in relation to your questions is that it intensifies. It confronts us with the fact that our ideas about these subjects are outmoded, come from a different epoch, and we had better get down to thinking them through in terms of a modern, futuristic setting.

Mr. VOLKMER. Mr. Chairman, could I just have 1 minute more?

Mr. GORE. Yes. I think that he wanted to respond to the question, but you do as you wish.

Mr. VOLKMER. Right. I want to go back to that solar cell again in Japan.

Mr. SERVAN-SCHREIBER. No, no, no. Since you have been kind enough to offer your time for this basic discussion, I would like to ask questions to your chairman and the panel.

You have been interested in the World Center and all that it means before we came here, because that is the reason for your invitation. Now, we have been discussing for 3 hours together on all these issues.

I would like to ask you this, Mr. Chairman. What is the strategy you have in mind to make the most of this effort at the World Center? Second, what is the strategy you have in mind for America, the United States, to take the maximum possibility of using this scientific revolution in time, which is now?

Mr. GORE. If my colleague will be generous with his time——

Mr. VOLKMER. Yes; you go ahead. I will defer to the chairman. That is a question to ask you. [Laughter.]

Mr. GORE. Yes; that reverses our normal procedure. We usually like to ask the questions. But I will try to answer.

As I said at the outset, I believe that all of the criticisms and questions about your vision and your plan to implement that vision pale in the face of the vision itself, which I think is a valid idea.

I admire your courage in trying to answer this interminable list of questions and problems that you will confront more and more as you try to put this into practice.

I would like to see the United States help in that effort. I believe that we human beings who are alive today may well be a make-it-or-break-it generation. I believe that history is speeding up and getting louder.

Perhaps it is a self-centered delusion of our age, but it does seem as if history is moving toward some sort of crescendo within the lifetimes of those men and women alive today, and that while that crescendo may not hold the capacity to destroy all human life, certainly we have the possibility of another decline, as one of you put it earlier.

I also believe that the path toward hope will require us to harness this exciting new tool, the computer. I believe that the solution to mankind's problem will involve a careful selection of the positive aspects of human consciousness as opposed to the residue of lo these many million years of other aspects of consciousness that have created so many of the problems that we have between people as well as among nations; and that the personal computer offers the possibility of extending those positive aspects of consciousness, preserving them and magnifying them, even as the industrial revolution extended muscle power and magnified muscle power.

In order to accomplish that task, we will have to face awesome problems of infrastructure, economics, politics, sociology, but the task is now, and we must face it. In this country, we must find a way to address these very same questions. We cannot understand the role of the United States and the proper function of the United States without reference to the larger world economy and world community.

Just as it is impossible for a physiologist to understand the human heart without reference to its role in pumping the blood to all parts of the human body, so it is impossible to understand the United States without reference to the global crisis that confronts mankind.

Our role in this country, I think, includes a sustained, energetic effort to model the hopes of all mankind to create a mental image that will encompass the hopes and dreams of mankind and will channel the efforts of people of good will in our two countries and

elsewhere in the world to solve the problems which line the path of this possibility.

If we do not, then this crescendo of history may very well swamp the tentative civilizations that we now enjoy. So the answer to your question is, I think that we in the United States should join in this effort, and your appearance here today and that of your colleagues marks the first in a series of hearings that your ideas, Mr. Servan-Schreiber, have stimulated us to undertake.

We have invited the leading computer experts in the United States, sociologists, and others to come here in a series of inquiries, a series of hearings, to answer this question. I cannot give you the answer. I can give you the outlines of what I think the answer should be.

But we will seek to find the answer here in the United States, and I hope that we will be successful in doing so.

Mr. SERVAN-SCHREIBER. Your committee might become one of the world centers in the network. [Laughter.]

Mr. VOLKMER. Mr. Chairman, I would just like to echo your statement, especially the last part. I do believe that it is a very valid concept that you have and that it does mean that in the future, if it is followed, we could have better means of communications and knowledge among all the peoples of the world.

But I do see, as I started to bring up, some problems with some of the areas of that knowledge, and the free flow of some of that knowledge may have some barriers to it, and I think those will have to be addressed as time goes on.

I agree with Professor Papert that we will probably have to need some changes in the way we think about some of the knowledge—in other words, whether that knowledge should be free to everyone or whether that knowledge should be restricted. Right now, a lot of it is restricted.

Mr. GORE. Without objection, I would like to include in the record of this hearing an article in the Cornell Journal of International Law by Jane Bortnick about the problems of infrastructure and how we might better solve them.

[The article mentioned above follows:]

INTERNATIONAL INFORMATION FLOW: THE DEVELOPING WORLD PERSPECTIVE

Jane Bortnick†

Discussions of international data flows have traditionally centered upon the industrialized nations, while often ignoring the less developed countries (LDCs, developing nations, or Third World).[1] Nevertheless, like the industrialized nations, the LDCs are major stakeholders in the debate on the international flow of information. The success of their drive for economic, social, and political development in a highly technological world is dependent increasingly upon their ability to acquire and effectively employ data processing and telecommunications technologies.[2] In an attempt to harness these technologies, a growing number of LDCs have adopted national informatics plans and policies.[3] These measures reflect the desire of the LDCs to gain access to economic and technical information that can aid the development process without creating a new type of dependence upon the developed world. In part, these actions create barriers to the international flow of information that may cause substantial injury to private enterprises attempting to enter and compete in LDC markets.[4]

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The views expressed herein are solely those of the author, and do not necessarily reflect those of the Congressional Research Service or the Library of Congress.

1. The Third World is not a homogeneous entity. Rather, the nations grouped under that rubric reflect varying levels of development as well as divergent goals and resources. Significant differences in political philosophy, economic advancement, and cultural heritage exist among the various LDCs. At the same time, the LDCs are unified by a shared desire to steadily improve their standard of living, to build stable national economies, and to compete in the international marketplace while preserving their unique cultural identities.

2. The acquisition and successful employment of modern communications and information technologies, as well as access to scientific and technical information, are essential to development. For a discussion of how informatics technology promotes the economic, social, and political development of the LDCs, see notes 7-11 *infra* and accompanying text.

3. HOUSE COMM. ON GOVERNMENT OPERATIONS, INTERNATIONAL INFORMATION FLOW: FORGING A NEW FRAMEWORK, H.R. REP. NO. 1535, 96th Cong., 2d Sess. 31 (1980) [hereinafter cited as HOUSE REPORT].

4. *Id.* at 23-27, 31.

Furthermore, the LDCs have been increasingly vocal in expressing their information needs and concerns in numerous international fora.[5] Several international organizations have begun to focus on the need to harmonize the information needs and concerns of the developed and developing nations.[6] It is difficult to ascertain at this time the full impact of the LDCs on international debates concerning information and communications policies. However, there is growing evidence that they may significantly affect the establishment of international agreements in the area of informatics.

This Article studies the actions of the LDCs: those taken unilaterally by the individual countries and multilaterally as members of international organizations. Section I discusses the problems that prevent LDCs from acquiring sophisticated information technologies. Section II discusses the developing nations' national informatics plans, analyzing the reasons for their adoption and the effects they have on multinational private enterprises. Section II includes a special case study of the Brazil national informatics policy. Finally, Section III discusses the international organizations that have taken measures to aid the LDCs in the development of their information and communications technologies and in which the developing countries are taking an active role.

I
INFORMATION PROBLEMS AND PERSPECTIVES OF THE THIRD WORLD

The success of the LDCs' quest for economic, social, and political development depends significantly upon their ability to develop and employ technologies related to informatics. "Informatics is the rational and systematic application of information to economic, social, and political development."[7] Informatics fosters economic development by facilitating both the acquisition and the use of scientific and technical data.[8] For example, access to remote databases, combined with the ability to gather and analyze domestic resource

5. *See generally* AMERICAN FEDERATION OF INFORMATION PROCESSING SOCIETIES, TRANSBORDER DATA FLOWS: CONCERNS IN PRIVACY PROTECTION AND FREE FLOW OF INFORMATION 28 (R. Turn ed. 1979) [hereinafter cited as FREE FLOW]; Hamelink, *Informatics: Third World Call for New Order*, 29 J. COM. 144 (1979).

6. HOUSE REPORT, *supra* note 3, at 27-30.

7. INTERGOVERNMENTAL BUREAU FOR INFORMATICS, INFORMATICS: ITS POLITICAL IMPACT 2 (Jan. 1978) [hereinafter cited as POLITICAL IMPACT].

8. For a discussion of how informatics fosters the economic development of the LDCs, see generally POLITICAL IMPACT, *supra* note 7, at 8; Hamelink, *supra* note 5, at 144-46.

information, can enhance decisionmaking in support of national development. The LDCs, without engaging in extensive research of their own, can use this information as the basis for formulating their own technological and economic development programs. Informatics also facilitates processing of large amounts of data used to plan and control the implementation of these programs.[9] Informatics, likewise, fosters social development by educating people, by shaping and preserving cultural values, and by promoting social change.[10] Finally, informatics fosters political development by providing more input into the political decisionmaking process and by facilitating the planning and control of government plans and policies.[11]

The LDCs approach informatics problems from the perspective of information and technology "have-nots." Their concerns revolve around their lack of access to both technology and the world's store of knowledge. Lack of access not only means that LDCs have been unable to procure technical information from the outside world; it also means that once they obtain this information, they have been unable to fully utilize it.

The developing countries lack effective informatics systems for several reasons.[12] First, they lack a technolgocial infrastructure that provides an environment for indigenous research, development, and local innovation. The absence of a technological infrastructure is a severe handicap to the effective integration of modern communications and data processing systems into the unique environment of each developing nation. Of equal importance, the developing countries lack an information infrastructure.[13] An information infrastructure consists of the "complex of institutions, organizations, resources, and systems and services which support the flow and delivery of information from the generator to the users."[14] It provides a variety of information-handling services, institutions for acquiring, packaging, and distributing materials, government entities

9. POLITICAL IMPACT, *supra* note 7, at 8.

10. For a discussion of how informatics fosters the social and cultural development of the LDCs, see generally *id.* at 8-9.

11. For a discussion of how informatics fosters the political development of the LDCs, see generally *id.* at 9-17.

12. For a discussion of the LDCs' inability to develop effective informatics systems, see generally L. Agrawal, Problems and Limitations in Installation of Transborder Data Flow System in Developing Nations (June 1980) (unpublished paper presented at Intergovernmental Bureau for Informatics World Conference on Transborder Data Flow Policies); United Nations Educational, Scientific and Cultural Organization, Intergovernmental Conference on Scientific and Technological Information for Development: UNSIST II, U.N. Doc. PGI-79/CONF. 201/COL. 5 (18 April 1979) (Main Working Document of 1979 UNESCO Conference) [hereinafter cited as UNESCO Main Working Document].

13. UNESCO Main Working Document, *supra* note 12, at xi.

14. *Id.*

for articulating national information policies, modern communications and data processing equipment and services for facilitating information transfer, and a cadre of well trained and educated information professionals and information users. Computer technology is an ever-changing and developing field. Constant advancements require the ability to keep pace with ongoing technological development. The LDCs lack sufficient trained personnel to engage in research, and to install, maintain, and program indigenous computer systems.[15]

The other major difficulty facing the LDCs is their lack of available capital for investment in high technology products and services.[16] While hardware costs will presumably continue to decline as a result of electronic component miniaturization, software costs are rising. Unfortunately, the LDCs simply do not have the local expertise to produce their own software.[17]

The industrialized nations' attempts to help the LDCs develop their information and communications technologies have been piecemeal and often directed toward maintaining the status quo. While the United States has generated a good deal of rhetoric concerning the need to enhance information and communications development in the Third World, it has actually committed a minimal amount of funds.[18] The emphasis of United States foreign assistance, like that of many international organizations, is currently on "basic needs," such as food and health services. Because information and communications are not considered basic needs, they do not command priority funding.

The United States has made some effort to increase the availability of scientific and technical information in the developing world. Government and commercial vendors have made U.S. databases available to LDCs,[19] and numerous federal agencies have instituted information dissemination and technical assistance programs for developing countries.[20] A lack of interest and inadequate coordina-

15. L. Agrawal, *supra* note 12, ¶¶ 2.1(e), 2.2(c).

16. *Id.* ¶ 2.2(e).

17. *Id.* ¶ 2.2(c).

18. Honig, *Lessons for the 1999 WARC,* 30 J. COM. 48, 55 (1980). For a history of U.S proposals to provide financial assistance to the LDCs, see ACADEMY FOR EDUCATIONAL DEVELOPMENT, THE UNITED STATES AND THE DEBATE ON THE WORLD "INFORMATION ORDER" 5-6 (J. Gunter ed. 1978) [hereinafter cited as NWIO Debate].

19. U.S. DEPARTMENT OF STATE, THE INFORMATION RESOURCES AND SERVICES OF THE UNITED STATES: AN INTRODUCTION FOR DEVELOPING COUNTRIES (July 1979).

20. J. Bortnick, W. Schacht & L. Raleigh, The Role of the United States in Scientific and Technical Information Assistance for the Developing Countries 72-123 (March 13, 1980) (Part II of U.S. POLICIES OF THE DEVELOPING NATIONS: FOLLOW-UP TO THE U.N. CONFERENCE ON SCIENCE AND TECHNOLOGY FOR DEVELOPMENT AND U.S. PROGRAMS FOR SCIENTIFIC AND TECHNICAL INFORMATION ASSISTANCE (March 13, 1980) (A Con-

tion plague U.S. foreign aid efforts in the area of information and communications. Furthermore, in light of the current fiscal restraints on government spending, the outlook for foreign aid to the developing world for informatics in the near future is bleak.

Critics express further skepticism regarding the U.S. commitment to United Nations' efforts in this area. For example, the LDCs exerted substantial pressures to gain funding for improved scientific and technical support at the 1979 United Nations Conference on Science and Technology for Development.[21] These pressures resulted in the call for a world-wide scientific and technical information network.[22] While it was expected that the United States would contribute fifty million dollars toward increased science and technology assistance following the conference, the U.S. ultimately pledged merely $7.2 million.[23] Unless new approaches for assisting the LDCs are found, the developing countries will have difficulty acquiring the informatics technologies necessary for their economic, social, and political development.

II
DEVELOPMENT OF BARRIERS TO INFORMATION FLOW BY UNILATERAL ACTION

A. Reasons for Erecting Barriers

In some developing nations, information and communications resources are extremely limited and governments generally have paid little attention to associated policy issues. However, there is a growing trend—particularly among the middle-tier developing nations—to articulate national informatics policies, long range plans, legal and regulatory environments, and to develop indigenous data processsing and telecommunications industries.[24] In part, these measures have led to the erection of barriers to the free flow of infor-

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gressional Research Service—Science Policy Research Division document)) [hereinafter cited as Information Assistance].

21. G. Knezo, Implementation of Recommendations Made at the United Nations Conference on Science and Technology for Development 1-20 (March 13, 1980) (Part I of U.S. Policies for the Developing Nations: Follow-up to the U.N. Conference on Science and Technology for Development and U.S. Programs for Scientific and Technical Information Assistance (March 13, 1980) (a Congressional Research Service—Science Policy Research Division document)).

22. For a discussion of the U.S. position on the LDC demands at this Conference, see *id.* at 20-57.

23. Broad, *Fund for U.N. Science Center Short by $200 Million,* 208 Science 475 (1980).

24. In his opening address to the Intergovernmental Bureau for Informatics Conference on Transborder Data Flow Policies in Rome in June 1980, IBI Director General F.A. Bernasconi noted that more than 60 LDCs have established informatics plans and

mation.[25] The LDCs view these barriers as necessary to protect various economic, political, and social interests.

One reason for the development of informatics policies and the erection of barriers to the flow of information is the preservation of national sovereignty.[26] Information is a resource that yields economic, political, and technological advantages. National sovereignty, in the context of information, refers to a country's desire to control its own information resources and the advantages flowing therefrom. Other countries' use of these resources threatens the LDCs' national sovereignty by undermining this control.[27]

The threat is of particular concern to developing nations because they lack the data processing and telecommunication tools to fully exploit their information resources. For example, natural resources, as compared to manufactured goods or service industries, form the basis of many economies in the LDCs. They lack, however, the facilities to process, store, and analyze natural resource data. Consequently, the LDCs must utilize foreign data processing and communications services to perform the necessary information processing functions, and then buy back the processed information at a higher price.[28] One commentator notes that "this cycle of transborder data flows is quite similar to cycles in other trade areas where industrially less developed countries export raw materials (e.g., ores, rubber, timber, oil) to industrialized countries and then purchase back the more costly, finished products."[29] In this way, LDCs are deprived of the jobs that the processing of information creates.[30] Control over information resources is undermined, and hence, national sovereignty is threatened.

Another impetus for the erection of barriers is the LDCs' fear of

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authorities. Bernasconi, *Accepting the Challenge of New International Responsibilities*, 3 TRANSNAT'L DATA REP. No. 3/4, at 3, 4 (1980).

25. HOUSE REPORT, *supra* note 3, at 31.

26. For a discussion of national sovereignty as it is related to information flow, see HOUSE REPORT, *supra* note 3, at 20-21; Eger, *The Global Phenomenon of Teleinformatics: An Introduction*, 14 CORNELL INT'L L.J. 203, 231-34 (1981); Novotny, *Transborder Data Flows and International Law: A Framework for Policy-Oriented Inquiry*, 16 STAN. J. INT'L L. 141, 160-66 (1980).

27. A good example of such a threat is the developed nations' use of satellite remote sensing. Data that are acquired via remote sensing are openly available. The LDCs lack, however, the ability to interpret these data due to few technicians and limited computer technology. In contrast, the developed countries and multinational corporations often can afford both trained personnel and sophisticated equipment. Consequently, LDCs fear that foreign nations and multinational enterprises will have a superior bargaining position in negotiating contracts concerning natural resources. For a discussion of remote sensing, see notes 92-96 *infra* and accompanying text.

28. *See* FREE FLOW, *supra* note 5, at 3-4.

29. *Id.* at 4.

30. *Id.*

vulnerability.[31] LDCs depend heavily on foreign firms for telecommunications and data processing equipment and services. Often, critical economic and political data are stored entirely in computer banks outside the country. The LDCs worry that the location of these sensitive data abroad makes them vulnerable to disruptions due to technical failures, manipulation, or even political sabotage.[32] In addition, they fear that the basis for important national decisions is located extra-territorially.[33] Finally, the LDCs fear that personal information may be compromised if it is stored in a country with lower standards of confidentiality.[34] Although developed nations share these vulnerability concerns, the fear is often deeper for the LDCs because of the high degree to which they are dependent upon foreign nations for the performance of information-related functions.[35]

Another factor prompting the erection of barriers is the LDCs' fear of cultural erosion.[36] The foreign media provides an ongoing flow of news and entertainment programs to the LDCs. These programs introduce values and perspectives that often conflict with those traditionally held in the LDC. Many LDCs view seriously the threat that this inundation poses to the cultural identity of the importing country. Developing countries likewise are concerned that cultural erosion extends beyond media programming to all forms of data flow that may reflect the institutions and traditions of the producing country. The growing computerization of all types of information accentuates the convergence of mass media and transborder data flow questions.[37] Although shared by the developed nations, this concern is of particular importance to the LDCs where citizens have had limited exposure to foreign values, have high illit-

31. For a discussion of the vulnerability issue, see HOUSE REPORT, *supra* note 3, at 21-22; INTERGOVERNMENTAL BUREAU FOR INFORMATICS, ISSUES ON TRANSBORDER DATA FLOW POLICIES 1-2 (Sept. 1979) [hereinafter referred to as DATA FLOW POLICIES]; Hamelink, *supra* note 5, at 147-48.

32. *Id.* at 1; HOUSE REPORT, *supra* note 3, at 21-22.

33. DATA FLOW POLICIES, *supra* note 31, at 1; Hamelink, *supra* note 5, at 147.

34. DATA FLOW POLICIES, *supra* note 31, at 2.

35. HOUSE REPORT, *supra* note 3, at 21.

36. For a discussion of the LDC's fear of cultural erosion from the foreign media and the impact of this fear on informatics policies, see generally HOUSE REPORT, *supra* note 3, at 23; FREE FLOW, *supra* note 5, at 13-14; Masmoudi, *The New World Information Order*, 29 J. COM. 172 (1979); Righter, *Battle of the Bias*, 34 FOREIGN POL'Y 120 (1979); Righter, *The Political Challenge to the Western Press: Another "New Order"?*, 35 WORLD TODAY 167 (1979); Address by Joubert de Oliviera Brizida, Executive Secretary of the Brazilian Special Secretariat of Informatics, 1980 Intergovernmental Bureau for Informatics Conference on Transborder Data Flow Policies in Rome, Italy (June 23, 1980), *reprinted in* 3 TRANSNAT'L DATA REP. No. 3/4, at 32 (1980) [hereinafter cited as BRAZILIAN ADDRESS].

37. *Id.* at 33.

eracy rates, and have few domestic information sources to use as alternatives.

Finally, some LDCs have erected barriers to protect themselves from over-dependency on foreign technology and information services.[38] The following section examines this situation.

B. Brazil: A Case Study

Brazil is seen as a leader in the area of informatics policy development and serves as a major Third World spokesman at international meetings. The Brazilian informatics policy demonstrates how LDCs can create a regulatory environment to achieve the objectives discussed above. It also shows how LDCs can exert pressure on their trading partners to accomplish these goals.

The Brazilian informatics policy is geared to the achievement of several objectives including the development of domestic telecommunications and computer industries, and the regulation of transborder data flows in the interests of national sovereignty and economic growth.[39]

The Brazilian government established the Coordinating Commission on Data Processing Activities (CAPRE) in 1972 to oversee the federal government's acquisition and use of computers.[40] By 1975, Brazil's annual expenditures for data processing equipment had skyrocketed to $275 million, nearly all of which consisted of imports from foreign countries.[41] Significant balance of trade defi-

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38. *See* POLITICAL IMPACT, *supra* note 7, at 18-19.

39. Restrictions on information flow serve as devices to protect the national sovereignty, vulnerability, and cultural erosion concerns of the LDCs until their own informatics technologies develop to the point at which the particular country becomes less dependent upon the developed countries. "Protection is a needed tool to bridge the dependence gap, and is to be removed gradually as indigenous capacity is able to face exogenous competition." Saur, *Informatics, New Technologies and Data Regulation: A View From the Third World,* in DATA REGULATION: EUROPEAN & THIRD WORLD REALITIES 223, 224 (On Line 1978) [hereinafter cited as Third World View].

Executive Secretary Brizida of SEI summarized the major purposes behind the Brazilian plan:

> The aim of such control is not to restrain the information flow but rather to give commercial reciprocity to the exchange of information among countries. It concerns the use of data banks, software, data processing capability and other facilities. In terms of strategy, it is fundamental that a country have control over the information resources essential to its sovereignty and development. Thus, the international commerce of information products and services must be submitted to conditions related to their content.

BRAZILIAN ADDRESS, *supra* note 36, at 33-34. *See also* Brizida, *The Brazilian Transborder Data Flow Policy,* 4 TRANSNAT'L DATA REP. No. 3, at 19 (1981).

40. M. Ripper & J. Wanderley, The Brazilian Computer and Communications Regulatory Environment and Transborder Data Flow Policy 3 (June 1980) (unpublished paper presented at the Intergovernmental Bureau for Informatics World Conference on Transborder Data Flow Policies) [hereinafter cited as Brazilian Policy].

41. *Id.*

cits resulted.[42] The growing awareness of the importance of computer technology to the successes of national development policies and to the solution of the Brazilian balance of trade problem prompted the Brazilian government, in 1976, to enlarge CAPRE's scope of responsibility.[43] Instead of merely overseeing the governments' acquisition and use of computers, CAPRE became responsible for the supervision of private users' acquisition and use of computers.[44] CAPRE approval was a prerequisite to the importation of computer parts.[45] In addition, CAPRE received the power to establish a total quota of computer parts that could be imported. Finally, CAPRE became responsible for proposing a national informatics policy.[46]

CAPRE examined applications for the import of computer equipment on a case-by-case basis. CAPRE delineated the criteria for implementing the import quota by assigning priority to projects with high nationalization content, high exporting potential, high technological absorption capacity or total technology transfer in the case of joint ventures, favorable market share implications, and controlling capital in the hands of Brazilians.[47] Domestic manufacturers were encouraged to manufacture computer equipment; those using their own technology would receive priority treatment when implementing the import quota.[48] Above all, no foreign computers could be used "which through teleinformatics accomplish tasks whose solution can be obtained in the country."[49] Through such means of regulating imports, Brazil sought to protect its nascent computer industry.[50]

In 1979, the Brazilian Government established the Special Informatics Agency (SEI) to replace CAPRE.[51] The SEI is part of the National Security Council and acts as an advisory body to the President.[52] SEI's responsibilities are greater than those of CAPRE. SEI proposes the national informatics plan and is responsible for its

42. Third World View, *supra* note 39, at 232.
43. Brazilian Policy, *supra* note 40, at 4.
44. *Id.*
45. The criteria CAPRE delineated for determining whether they would approve the import of a particular computer part are set forth in text accompanying note 47 *infra*.
46. *Id.*
47. *Id.*
48. *Id.*
49. BRAZILIAN ADDRESS, *supra* note 36, at 33.
50. Brazil regulates the importation of computer parts as part of its strategy to manage its balance of payments problem. A government council limited imports of computer parts to 130 million U.S. dollars in 1978. Economists conservatively estimate that without CAPRE regulation, 1978 imports would have exceeded 300 million U.S. dollars. Third World View, *supra* note 39, at 233.
51. BRAZILIAN ADDRESS, *supra* note 36, at 32.
52. *Id.*

execution. SEI oversees all aspects of the manufacture and use of electronic components. Finally, and of key importance, SEI regulates all transborder data flows from other countries.[53]

SEI examines potential transborder data flows and international information services on an individual basis.[54] SEI then determines what the impact of the services will be in terms of economic, privacy, and national sovereignty concerns.[55] Based upon this analysis, the application is either accepted, rejected, or conditionally accepted.[56]

These data controls are not designed solely for the computer and communications industries. International operations of all kinds, especially in the service sector, require information flows. The role that information plays in supporting industries such as banking and insurance is unquestioned and is receiving increased attention in Brazil. The Brazilian transborder data flow policy applies equally to all types of information that are considered commercial products with corresponding economic value.[57]

Most recently, Brazil has proposed the employment of "gateways" for channeling information as a means for systematizing data traffic into and out of the country.[58] The establishment of such a communications mode would increase government control and provide more effective means for tariffing information flows.[59]

C. Effects of Barriers on Multinational Corporations

Transborder data flow regulations have significant consequences for multinational enterprises either operating or attempting to enter markets in the developing world. Focusing on the Brazilian regulations, these consequences become readily apparent.[60] Multinational corporations first encounter barriers at the application stage.[61] Processing applications for the sale or purchase of information products and services can be time-consuming and costly. Application and inspection requirements may compromise proprietary information. For example, the Brazil application requires the applicant to provide information about the company, the services being

53. Brazilian Policy, *supra* note 40, at 5.

54. Brizida, *The Brazilian Transborder Data Flow Policy*, 4 TRANSNAT'L DATA REP. No. 3, at 19, 19-21 (1981).

55. *Id.*

56. *Id.*

57. BRAZILIAN ADDRESS, *supra* note 36, at 34.

58. *Id.*

59. *Id.*

60. A compendium of letters from multinational enterprises commenting on barriers to international data flow can be found in *International Data Flow: Hearings Before a Subcommittee of the House Comm. on Government Operations*, 96th Cong., 2d Sess. app. 3 (1980) [hereinafter cited as *Hearings*].

61. *See* note 55 *supra* and accompanying text.

provided, and the resources needed for implementing those services. Furthermore, the company must report its objectives for making the transfer.[62] Clearly, much of this information may otherwise be confidential.

Brazil does not allow the importation of information services if the service could be provided domestically.[63] A multinational corporation desiring to operate in Brazil, therefore, may be forced to establish duplicate data processing facilities in Brazil rather than receive services or equipment directly from abroad.[64] Consequently, the cost of doing business may drastically increase. Furthermore, the unavailability of adequate equipment and services produced in Brazil may lead to less efficient operations. In order to avoid the increases in costs or requirements to provide proprietary information, many enterprises may revert to less effective means of communicating world-wide. Finally, the increase in cost and decrease in efficiency may simply preclude an enterprise from entering a market such as Brazil.[64]

It is too early to determine the full impact of Brazil's regulatory structure on multinational corporations. Likewise, the effect of these protectionist measures on Brazilian economic growth is uncertain. However, the establishment of similar regulatory frameworks in other developing countries could have significant repercussions for businesses attempting to expand their operations into the developing world. While existing LDC markets are small compared with those of the industrialized countries, the opportunity for growth is substantial.[66] At present, multinational firms face numerous difficulties when dealing with developing countries and often consider these endeavors risky.[67] Increased regulation may further inhibit multinational enterprises from exploring the potential of emerging markets in the developing world.

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62. Brazilian Policy, *supra* note 40, at 6.

63. BRAZILIAN ADDRESS, *supra* note 36, at 33.

64. *Hearings, supra* note 60, at 739.

65. For a general discussion of the impact of barriers to the flow of information, see HOUSE REPORT, *supra* note 3, at 23-27 and *Hearings, supra* note 60, at 139.

66. ARTHUR D. LITTLE, WORLD TELECOMMUNICATIONS STUDY II: 1980-1990 (1980); Szuprowicz, *The World's Top 50 Computer Import Markets*, DATAMATION 141 (1981).

67. U.S. DEP'T OF COMMERCE, TRADE ISSUES IN TELECOMMUNICATIONS AND INFORMATION: PROMOTING U.S. TRADE IN TELECOMMUNICATIONS AND INFORMATION PRODUCTS WITH DEVELOPING COUNTRIES (NTIA Report 81-72, 1981).

III
LDCs IN THE INTERNATIONAL ARENAS

In addition to unilaterally developing national information policies, the LDCs have emerged as a significant coalition at international meetings where unified expressions of their common concerns have made a significant impact on the resolution of conflicts, the development of new international agreements and codes of conduct, and the setting of future agendas. A demand for the creation of a "new world information order" (NWIO) accompanies their call for a "new world economic order" at these meetings.[68] One commentator defines the NWIO as the "international exchange of information in which nations, which develop their cultural system in an autonomous way and with complete sovereign control of resources, fully and effectively participate as independent members of the international community."[69] In other words, under the NWIO, the LDCs would have equal access to the world's store of knowledge and other information resources and would control foreign media reporting from their countries.[70]

Debates on the need for a NWIO have been ongoing in several international arenas,[71] although the United Nations remains the key forum for these discussions. Though the NWIO debates often center on concerns of cultural imperialism and freedom of the press,[72] these issues are only part of the larger spectrum of information flow issues reflecting more general economic and social goals of the LDCs. The NWIO promotes these broader concerns by emphasizing the need to achieve a balance between developed and developing nations that will enable the LDCs to become active participants in the world

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68. For a discussion of the LDCs' demands for a New World Information Order, see generally NWIO Debate, note 18 *supra*, Dizard, *The U.S. Position: DBS and Free Flow*, 30 J. COM. 157 (1980); Hamelink, note 5 *supra*; Masmoudi, note 36 *supra*; Righter, *Battle of the Bias*, 34 FOREIGN POL'Y 120 (1979); Righter, *The Political Challenge to the Western Press: Another "New Order"?*, 33 WORLD TODAY 167 (1979); C. Hamelink, The New International Information Order: Development and Obstacles (Occasional Paper 80/2 of the Vienna Institute for Development [hereinafter cited as Development and Obstacles].

69. Hamelink, *supra* note 5, at 146.

70. One key LDC proponent of the NWIO defines it in the following manner:

> The new world information order founded on democratic principles seeks to establish relations of equality in the communications field between developed and developing nations and aims at greater justice and greater balance. Far from calling in question the freedom of information, it proposes to ensure that this principle is applied fairly and equitably for all nations and not only in the case of the more developed among them . . . .

Masmoudi, *supra* note 36, at 178.

71. For a chronology of meetings at which the need for an NWIO was debated, see generally Development and Obstacles, note 68 *supra*.

72. *See* notes 36-37 *supra* and accompanying text; *see also* note 68 *supra* and accompanying text.

marketplace and partners in an increasingly interdependent world. The LDCs view this balance not simply in terms of the news media, but equally in terms of access to scientific and technical information, telecommunications facilities, and the distribution of the frequency spectrum.

Achieving that balance requires limiting information flows in some circumstances while encouraging them in others. Culturally biased information originating from the industrialized nations and broadcast to the developing world is often considered anathema, while vital technical data is highly sought after. In sum, the NWIO, like many LDC national informatics policies, requires placing some degree of control on information flows. This section discusses several international organizations and proposals through which nations have multilaterally attempted to address NWIO demands.

A. United Nations

The United Nations Economic, Social, and Cultural Organization (UNESCO) is the primary forum for debate on the mass media issues.[73] These issues result from a clash between two competing perspectives. The 1946 United Nations Declaration on Freedom of Information provides that "all states should proclaim policies under which the free flow of information within countries and across frontiers will be protected."[74] Two years later, the Universal Declaration of Human Rights added further support to the "free flow" concept by providing that "everyone has a right to freedom of opinion and expression; this right includes freedom to hold opinions . . . to seek, receive, and impart information and ideas through any media and regardless of frontiers."[75]

The LDCs have continually sought to alter these principles. They fear that the unrestricted flow of information will lead to cultural domination by the western mass media.[76] Moreover, at numerous UNESCO meetings the Soviet Union has sought greater controls over the press. For example, at the 1976 UNESCO General Assembly the Soviet Union introduced a draft Declaration on Mass Media,

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73. For a discussion of the mass media issues, see generally A. Smith, The Geopolitics of Information (1980); Masmoudi, note 36 *supra*; Righter, *Battle of the Bias*, 34 Foreign Pol'y 120 (1979); Righter, *The Political Challenge to the Western Press: Another "New Order"?*, 35 World Today 167 (1979).

74. United Nations General Assembly Resolution 59(I), Sixty-fifth Plenary Meeting, 14 December 1949, *reprinted in* United Nations Resolutions, Series I, General Assembly 1946-48 (D. Djonovich ed. 1972).

75. Universal Declaration of Human Rights, G.A. Res. 217 (III) U.N. Doc. A/810, at 71, art. 19 (1948).

76. *See* notes 36-37 *supra* and accompanying text.

expressing the need for state control over the press.[77] This draft became the subject of intense controversy at UNESCO. In an effort to avoid further dissension, the proponents substantially revised the draft and presented it at the 1978 General Assembly.[78] While the revised draft affirmed basic human rights and maintained the freedom of journalists, it also asserted the need for a new, more just and effective information and communication order, intended to strengthen international peace and understanding and based on a "free flow and a wider and better balanced dissemination of information."[79] This compromise failed to settle the debate over the free flow of information; it merely restated the issue that remains a rallying point for the LDCs and a major concern to Western journalists.[80]

In 1977, UNESCO established the International Commission for the Study of Communications Problems.[81] UNESCO hoped that the Commission would resolve the mass media debates and provide a comprehensive and independent view of the future role of communications. Rather than calming the debate, the Commission's final report, the "MacBride Report,"[82] renewed the controversy by raising some disturbing questions about the relationship between modern telecommunications and information technologies and the production and delivery of mass media programming.

The MacBride Report offers over eighty recommendations for implementing its objectives.[83] Although asserting fundamental principles of freedom of the press,[84] the report supports many LDC concerns affecting electronic international information flows such as "differential communications pricing policies,"[85] "international

77. *See* NWIO Debate, *supra* note 18, at 17-24, for a discussion of relevant United Nations Documents.

78. Declaration on Fundamental Principles Concerning the Contribution of the Mass Media to Strengthening Peace and International Understanding, to the Promotion of Human Rights and to Countering Racialism, Apartheid and Incitement to War, Resolution 4/9.3/2 adopted by the General Conference at its twentieth session, 1 RECORDS OF THE GENERAL CONFERENCE, TWENTIETH SESSION, PARIS, 24 OCTOBER TO 28 NOVEMBER 1978 (Resolutions) 100-04 (UNESCO).

79. *Id.* art. I, at 102.

80. At a May 1981 Conference, representatives of free press organizations issued a formal declaration "Declaration of Talloires" opposing Third World and Soviet efforts in UNESCO to adopt principles regulating the media. In addition, several Congressmen introduced resolutions in the 97th Congress opposing UNESCO efforts to restrict freedom of the press. H.R. Res. 142, 97th Cong., 1st Sess., 127 CONG. REC. H2328 (daily ed. May 19, 1981) (Mr. Shamansky); H.R. Con. Res. 137, 97th Cong., 1st Sess., 127 CONG. REC. H2328 (daily ed. May 19, 1981) (Mr. Stark).

81. INTERNATIONAL COMMISSION FOR THE STUDY OF COMMUNICATION PROBLEMS, MANY VOICES, ONE WORLD 295 (1980).

82. *Id.*

83. *Id.* at 253-72.

84. *Id.* at 233.

85. *Id.* at 257.

action . . . to alter telecommunication tariffs that militate against small and peripheral users,"[86] and more equitable sharing of the electro-magnetic spectrum and the geostationary orbit "as the common property of mankind."[87] In sum, the MacBride Report suggests a panoply of changes to existing international regulations and agreements, and proposes the formulation of new legal tools to ensure more equitable access to and use of modern information and communications technology in the developing world.[88]

The MacBride Report was the subject of considerable debate at UNESCO's Twenty-first General Conference in Belgrade in October 1980. Ultimately, the Conference passed a resolution that commends the MacBride Report, but refused to endorse its recommendations.[89] Significantly, the Conference created an International Program for Development of Communications (IPDC).[90] The IPDC, operating as a separate entity within UNESCO, is designed to improve information infrastructures and train personnel in the LDCs.[91] Although the IPDC provides a new opportunity to strengthen LDC communications capabilities through a cooperative effort between the developed and developing world, observers fear that the LDCs may use the IPDC as a vehicle for espousing their views on the Western mass media's cultural domination. Lack of funding may similarly hinder the operation of the IPDC.

The United Nations has also served as a forum for dispute over the controversial areas of remote sensing and direct broadcasting from satellites.[92] Satellite remote sensing can provide extensive information on natural resource deposits located within the LDCs.[93] Developing countries can use this information for more effective planning and utilization of these resources. The LDCs, however, motivated by national sovereignty concerns, fear that the remotely sensed natural resources data that foreign governments and multinational corporations acquire could be used against them.[94] Presently,

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86. *Id.*

87. *Id.* at 258.

88. For a presentation of different perspectives on the MacBride Report, see COMMUNICATION IN THE EIGHTIES: A READER ON THE "MCBRIDE REPORT" (C. Hamelink ed. 1980).

89. *Belgrade 1980: Breakdown or Breakthrough?*, 1 CHRON. INT'L COM. 2 (1980).

90. *Id.*; Special Political Comm.: Questions Relating to Information, 35 U.N. GAOR, Annex (unedited Agenda Item 59) (Dec. 1980).

91. *Id.*

92. The International Telecommunications Union (ITU) has also served as a forum for dispute on the issues direct broadcasting raises. For a discussion of United Nations and ITU debates on these issues, see generally Dizard, note 68 *supra*.

93. *See* notes 26-30 *supra* and accompanying text.

94. For example, remote sensing technology has been used to "track the desert locust in the Sahara, to map largely unknown regions of Brazil, to inventory forest land in

there are no restrictions on the dissemination of data obtained through remote sensing. The LDCs propose to restrict the distribution of these data and to condition the allowance of remote sensing upon the receipt of prior consent from the target country.[95] Likewise, fears of cultural erosion have prompted the LDCs to insist upon agreements prohibiting direct broadcasting from satellites unless the broadcaster receives prior consent from the receiving nation's government.[96] The United Nations Committee on the Peaceful Uses of Outer Space has held numerous debates on these issues, but has been unable to successfully resolve them.[97]

Another United Nations agency that is currently addressing the issue of transborder data flow is the United Nations Commission on Transnational Corporations. Slated as an agenda item for the Commission's September 1981 meeting is a recently prepared report by the United Nations Centre for Transnational Corporations entitled "Strengthening the Negotiating Capacity of Developing Countries."[98] The two-part report examines the role and impact of transnational corporations in transborder data flows and provides an overview of the economic, political, social, and legal implications of transborder data flows for developing countries.[99] These activities reflect the growing number of agencies within the United Nations system that are studying various aspects of the international data flow question and may be forums where new agreements regarding these issues are proposed.

B. International Telecommunications Union

The International Telecommunications Union (ITU), the oldest international organization, is an acknowledged arena for the development of regulations and standards for international telecommuni-

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Thailand, to search for iron ore in Egypt, and to determine land use and land capability in Tanzania." Information Assistance, *supra* note 20, at 115-16.

95. Subcomm. on Space Science and Applications of the House Comm. on Science and Technology, World-Wide Space Activities, H.R. Doc. No. 352, 95th Cong., 1st Sess. 471 (1977).

96. The "prior consent" issues revolve around whether transmitting and receiving countries should obtain a priori agreement. The Soviet Union and many developing countries favor this approach. The United States maintains that such regulations are premature. A compromise approach favors prior consent on the transmissions from satellites unrelated to content. *See* Dizard, *supra* note 68, at 162, for a discussion of these different viewpoints.

97. *See generally* NWIO Debate, *supra* note 18, at 19-24.

98. Commission on Transnational Corporations, Transnational Corporations and Transborder Data Flows: An Overview, 7 U.N. GAOR (Provisional Agenda, Item 8), U.N. Doc. E/C.10/87 (1981).

99. *Id.*

cations.[100] The ITU employs a consultative process to ensure that national telecommunications systems can connect with each other.[101] Its pronouncements have a critical impact upon the international flow of data. Of its current membership of 154 nations, over one hundred members are LDCs. The ITU operates on the basis of a single vote for each member country. Consequently, the LDCs, through collective support, can substantially influence the outcome of ITU deliberations.

The ITU sponsors the World Administrative Radio Conference (WARC), which reviews and revises international regulations concerning frequency allocations within the electromagnetic spectrum. Traditionally, frequencies have been allocated on a "first come-first served" basis that favors the industrialized nations that presently have substantial communications equipment. According to some estimates ten percent of the world's population presently controls ninety percent of the spectrum. The LDCs insist that the first come-first served principle be abandoned in favor of a priori planning to ensure that an adequate number of frequencies and orbital slots will be available for LDC use at a time when they have acquired more sophisticated communications technologies.[102] The United States' position is that the developing countries need not be concerned because improvements in technology will permit expanded use of the spectrum by the time the LDCs require it and a priori planning will only inhibit useful technological advances.[103]

Many observers anticipated that the most recent WARC conference, held in 1979,[104] would erupt into a political debate between developed and developing countries on frequency allocation issues. Although several areas of dispute emerged, the debate never took place at the Conference. There are several possible explanations for this. One participant emphasized that although the developing nations constituted seventy-two percent of the voting delegation, they constituted only fifty-one percent of the total number of dele-

100. The International Telegraph Union, founded in 1865, merged with the International Radiotelegraph Union to become the International Telecommunications Union in 1934. For a concise presentation of the operations of the ITU, see O'Neill, *The International Telecommunication Union*, 1981 TELECOM. 25.

101. The two consultative committees are the International Radio Consultative Committee (CCIR) and the International Telegraph and Telephone Consultative Committee (CCITT). Through a number of study groups, the CCITT recommends communications tariffs, technical standards, and operating protocols. Although adherence to CCITT recommendations is voluntary, these recommendations are generally accepted by governments and industries alike.

102. *Hearings, supra* note 60, at 819.

103. *Id.*

104. *The World Administrative Radio Conference of 1979: U.S. Preparations and Prospects, reprinted in* 125 CONG. REC. S9312 (daily ed. July 12, 1979).

gates at the Conference.[105] Because of the way the Conference performed its work in committees and subcommittees, many of the developing nations did not have enough delegates to be represented on each subcommittee.[106] Consequently, "subcommittee and working group meetings were dominated by the developed nations."[107]

Another reason for the lack of outright confrontation is the fact that the 1979 Conference postponed major frequency and orbital slot allocation issues for future regional and specialized WARC Conferences to be held over the next several years. It is at these meetings, in addition to the 1982 Plenipotentiary Conference of the ITU, that the industrialized nations will face the LDCs' growing pressure for increased access to the spectrum and for more funding for technical assistance programs.[108] The fact that several of these meetings were scheduled despite opposition from countries like the United States reflects the LDCs influence at the 1979 WARC.[109] As a result, the real strength of the LDCs in the ITU may not be tested until these meetings are held.

C. Intergovernmental Bureau for Informatics

The purpose of the Intergovernmental Bureau for Informatics (IBI), an international organization consisting of forty members, is to provide assistance to developing countries in the application of information and communications technologies. In addition, IBI provides a forum for the developing nations to promote new informatics policies for the LDCs and to discuss the economic, social, and legal effects of the new informatics technologies.[110] Given the politicization of UNESCO and the limited scope of the ITU, the IBI may offer an alternative forum for balancing the interests of developed and developing countries on informatics and transborder data flow problems. Currently, however, few developed countries are members of the IBI.[111]

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105. Honig, *Lessons for the 1999 WARC,* 30 J. Com. 48 (1980).
106. *Id.*
107. *Id.*
108. *Id.* at 48.
109. *Hearings, supra* note 60, at 807; Academy for Educational Development, Results and Implications for WARC 79 For Development Communications: A Report to USAID (Feb. 1980); N. Bowie, Third World Countries at WARC: Positions and Achievements (unpublished paper presented at Conference on World Communications: Decisions for the Eighties, Annenberg School of Communications, University of Pennsylvania, May 13, 1980).
110. The IBI was established under the auspices of the United Nations and UNESCO by Resolutions 22(III) of 3 October 1946, 160(VIII) of 10 August 1948, 318(XI) of 14 August 1950, and 340(XIII) of 24 August 1951, by the Economic and Social Council of the United Nations, and Resolution 2.24 by the General Conference at UNESCO.
111. Crawford, *The IBI Transborder Data Flow Conference: An American View,* 3 Transnat'l Data Rep. No. 3/4, at 38 (1980).

The IBI sponsors conferences on a regional and international level to debate informatics issues. In August 1979, the IBI and UNESCO co-sponsored the Intergovernmental Conference on Strategy and Policies in Informatics (SPIN), emphasizing the need for LDCs to reduce dependence on foreign technology and develop indigenous informatics capabilities. In June 1980, the IBI sponsored a Conference on Transborder Data Flow Policies. The IBI, at this conference, promoted LDC interests by proposing "to consider whether and in what ways government regulatory policies need to be reorganized,"[112] to explore the possibility of "introducing a registry or licensing system,"[113] to investigate the need to revise "traditional legal approaches to the protection of intellectual property,"[114] "to evaluate whether any new laws may be needed . . . in terms of ownership rights, liability and misuse,"[115] "to examine . . . jurisdiction over multinational corporations,"[116] "to clarify the concept of national sovereignty,"[117] to "define the scope of the principle of the free flow of information,"[118] and to "explore . . . preparation of international agreements."[119]

Although the Conference did not adopt any resolutions, it did establish two international working parties. One is charged with studying data protection and international law and the other is charged with studying the economic dimensions of transborder data flow.[120] The recommendations of these study groups will be the subject of discussion at IBI meetings to be held throughout various regions of the world and will ultimately be submitted to the second SPIN Conference scheduled for 1983.[121] Through these conferences and proposals the role of the IBI in shaping international communications and information policy will continue to expand and may provide a major forum for debating new agreements governing international information flow.

D. Impact of LDCs in International Arenas

The LDCs view international organizations, multilateral agreements, and international codes of conduct as effective tools to

112. Data Flow Policies, *supra* note 31, at 11.
113. *Id.*
114. *Id.* at 6.
115. *Id.* at 8.
116. *Id.* at 12.
117. *Id.* at 14.
118. *Id.*
119. *Id.* at 15.
120. *Rules to Facilitate TDF Envisioned,* 4 Transnat'l Data Rep. No. 3, at 26 (1981) interview with Prof. F.A. Bernasconi, Director General, IBI.
121. *Id.*

improve access to information resources and communications technologies.[122] For example, the LDCs can employ international codes of conduct to exert some degree of control over international commerce.[123] Codes of conduct, however, can be a double-edged sword. On one hand, they provide a means for harmonizing divergent national policies and for protecting the LDCs from economic, social, and political exploitation. On the other hand, they can restrict international commerce that, in general, benefits both developed and developing countries. Hence, both LDCs and developed countries have a substantial stake in carefully drafting international agreements so that the benefits to the LDCs outweigh the costs to international commerce in general.

International arenas provide a major framework for the debate and resolution of international telecommunications and information questions. Although many of the specific problems addressed at these organizations are technical in nature, the debate often takes on significant political dimensions. Because of their large numbers and their increased awareness of information-related problems, the LDCs, through international organizations, are taking an expanded role in determining transborder data flow policies. At the same time, the developed countries are beginning to recognize the need to respond to LDC concerns at international meetings with substantive strategies for international cooperation.

CONCLUSION

There has been an increasing awareness of the information-related problems and concerns of the LDCs in recent years. These countries have taken significant measures, both unilaterally and collectively in international fora, to solve these problems and to establish a new world information order. Many LDCs have adopted national informatics policies in an effort to develop their own information capabilities. In part, these policies have involved the erection

122. As one observer has noted:

> In recent years, and especially since the United Nations adopted the New International Economic Order . . . the LDCs in particular have pressed for the creation of international organizations to enforce new multinational agreements. . . . International bodies may be empowered with the authority to rap the knuckles of companies acting outside international agreements. International organizations may also be authorized to interpret agreements through some system of adminstration and review. They may further provide for settlement of disputes through conciliation, arbitration, or even adjudication. Codes of conduct would continue and even reinforce this kind of international intervention.

R. WALDMANN, REGULATING INTERNATIONAL BUSINESS THROUGH CODES OF CONDUCT 13 (1980).

123. *Id.*

of barriers to the free flow of information. What they represent is the LDCs' attempt to harness the benefits of modern technology without increasing their dependence on the industrialized world.

The developed nations are stakeholders in the success of the LDCs' quest for informatics development. Barriers to the flow of information infringe upon the ability of multinational enterprises to compete in international markets. Ultimately, such barriers may preclude some businesses from operating in certain developing countries. Finally, the barriers can seriously impair fundamental freedoms. To avoid these consequences, the industrialized countries must become more sensitive to LDC concerns and must begin to develop policies for dealing with their demands.

Simply providing additional funding will not solve the problem. The developing countries need assistance in establishing training programs and initiating local development efforts. In doing so, the developed countries must appreciate the legitimate LDC concerns regarding national sovereignty and cultural integrity. At the same time, the Western World must emphasize the importance of fundamental principles such as freedom of the press and demonstrate how modern technology can benefit, rather than harm, the interests of the developing world.

Because the world has become increasingly interdependent as a result of modern information and communications technology, new rules governing those technologies may be required. The developing nations are determined to become major players in these deliberations and will use their collective strength to support their positions. The developed nations also have a major stake in information and communications development in the LDCs. Failure to achieve cooperation on these issues would be detrimental to all nations.

Mr. GORE. We could continue this fascinating discussion for quite some time, but out of courtesy to our guests, I will not prolong it.

We do look forward, as do several Members of the House and Senate, to a more informal forum to just explore these ideas this evening.

Let me close the congressional hearing by again thanking you for not only your appearance here today but the pioneering work that you have done, Mr. Servan-Schreiber, and congratulating you and your colleagues for the heroic effort that you are undertaking. I really believe in it, and I count myself as one of your supporters here in the United States.

As I said a moment ago, many of us are interested in finding a way that the talents here in the United States of people who are expert in these fields can be organized in a complementary effort to face this world challenge.

Thank you very much for being here today. The hearing is adjourned.

[Whereupon, at 12:01 p.m., the subcommittees recessed, to reconvene at the call of the Chair.]

MEASURES TO ADDRESS THE IMPACT OF COMPUTER TECHNOLOGY ON LESSER DEVELOPED COUNTRIES

THURSDAY, JULY 15, 1982

HOUSE OF REPRESENTATIVES, COMMITTEE ON SCIENCE AND TECHNOLOGY, SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT, SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY.

Washington, D.C.

The subcommittee met, pursuant to notice, at 10:20 a.m., in room 2325, Rayburn House Office Building, Hon. Albert Gore, Jr. (chairman of the Subcommittee on Investigations and Oversight) presiding.

Present: Representatives Gore, Walgren, Shamansky, Dymally, Brown, Walker, Skeen, and Gregg.

Mr. GORE. The subcommittees will come to order.

One of our missions is to explore the question of technology transfer. We have examined in the past the impact of technology transfer and restrictions on transfers on academic freedom, peer review, innovation, research, and commercialization. We have explored the impact of technology transfer on commercial and academic institutions, on the domestic and international scale, and we have examined both legitimate and illegitimate transfers.

This morning we continue this exploration involving technology transfers in the Third World of what is surely one of the most potent and dramatic developments in technology, namely computers, and particularly microprocessors.

We will direct our inquiry so as to further identify ways in which computer technology can be adapted to the nonindustrialized nations and evaluate what the Government and the private sector are doing to develop this market.

Policies on technology transfer are at best a most delicate of balances. It may be considered wise for the United States to take every commercial and geopolitical advantage of a technological lead, such as the U.S. lead in microprocessing technology, by facilitating technology transfer, as it offers the opportunity to strengthen America's image, to assist developing nations and allies, and to strengthen our balance of trade.

At the same time however, policies providing for free flow of technology may squander a technological lead by giving away our best knowledge, by providing ready access to technology we may not want to transfer widely, and by otherwise assisting the aims of nations who do not have our best interests in mind.

It is ironic, if coincidental, that in this morning's New York Times is an article about the United States seizing a shipment of computers in a third country, lest the technology they embodied go to the Soviet Union.

When we consider the need to balance these concerns in an arena involving the fiercely competitive computer industry and the politically sensitive Third World, the delicacy of the questions becomes even more acute. Computers, particularly microprocessors, quite realistically have the potential to drastically change the way we live, the way we manufacture products, and the way we defend ourselves.

Take education for example. It is my hope that one day every classroom will have a computer terminal. I believe that microprocessing technology is likely to change the face of American education and that this will take place sooner rather than later. We anticipate legislation in this Congress that will accelerate those developments.

The potency, therefore, of computer technology is an excellent vehicle to use to focus discussion on the delicate issues associated with technology transfer, and if one is able to conceive of how advances in information processing technology will serve to shorten geopolitical distances and lead us to what is much more of a world community, we have to consider the developing world.

Since the UNSTAD conference in Vienna 3 years ago, the developing world has made it quite plain that they do not wish to be left behind in this technological revolution, and indeed a strong case, both economically. and politically as well as socially, can be made that it is in the best interests of the United States to develop and capitalize on our technological advantage. These desires have led to a number of formal international discussions about how information technology can make a giant step toward ameliorating the economic and technological gaps between the developing and industrialized nations. This is a trend we cannot afford to ignore.

Last month these two subcommittees heard representatives from the World Center for Microprocessing and Human Resources discuss an ambitious new effort by the French Government to develop microprocessing technology for education and ultimately to increase the computer literacy of the Third World. Whether this effort will succeed is the subject of much debate of course, but we cannot afford to lose sight of what may be a worthy goal merely because questions have been raised about the practicality of the effort and the vehicle chosen to deliver it.

We will address several questions today: Is it advisable for the United States to quickly transfer this technology? Is it feasible, considering the numerous practical problems of transferring microprocessing technology to the developing world, including the lack of infrastructure and suspicion of new technologies in many nonindustrial countries.

Last, ideology, theory, and altruism aside, we need to hear from the microprocessing industry as to whether there is even a market out there to begin with and whether and how a proposed program of transferring computer technology could or should integrate public and private undertakings.

I would like to ask unanimous consent that the statement of my cochairman, Doug Walgren, the chairman of the Science, Research, and Technology Subcommittee, be placed in the record at this point.

Without objection, it is so ordered.

[The opening statement of Mr. Walgren follows:]

OPENING REMARKS OF HON. DOUG WALGREN, CHAIRMAN, SCIENCE, RESEARCH AND TECHNOLOGY SUBCOMMITTEE, INTERNATIONAL TRANSFER OF COMPUTER TECHNOLOGY

I am pleased to co-chair these hearings on the International Transfer of Computer Technology with my colleague, Congressman Al Gore, Chairman of the Science and Technology Committee's Investigations and Oversight Subcommittee. The hearing today is a follow-up to the subcommittees' May 19 hearing on the new World Center for Microcomputer Science and Human Resources established by the Government of France.

At the May hearing, witnesses were extremely optimistic that previously identified barriers and conflicting views concerning equity, civil liberties, competitiveness, and transborder data flow would easily be resolved at the potential benefits of emerging information technologies were more adequately understood by the developing countries. At that hearing, I indicated that even though developing countries agree that satellite technolgy can bring valuable scientific and technical information to remore areas to promote development, this technology transfer can sometimes be perceived as an intrusion on local social values and the erosion of indigenous cultures. Thus, we will be interested to learn from our witnesses today their views of social, scientific, political, and economic barriers to the transfer of information and computer technology. We will also be interested in their perspective on the role of the Federal Government and the private sector in either facilitating or curtailing this technology transfer, how the development of comprehensive international communications and information policy can be enhanced, and how the benefits of computer technology can be maximized while decreasing the disadavantages for all international stakeholders.

Clearly, the impact of microelectronics will be widely felt in developed economies as evidenced by the fact that robots and automated factories—once science fiction—are already operational in Japan, Europe and the United States. Less clear, however, are the socioeconomic consequences of the widespread application of microprocessing in the developed countries and the potential international ramifications of the diffusion of telematics. The nature of the technology, and of the changes it will generate insures that the effects will not be felt solely in the advanced industrial economies. Third-world countries strongly linked with the world economy will also experience effects which could penetrate all aspects of economic, political, technical, and social relations at both the international and the national level.

Computer technology could be an important key to strengthing national capabilities, to stimulating scientific and technological progress, accelerating the development process, and enhancing economic cooperation among developing countries. Thus, equitable solutions to perceived barriers to the free flow of scientific data and the transfer of computer technology must be actively pursued as well as mechanisms to ensure that the entire international community can participate in the benefits associated with telematics. Current U.S. policies and programs to assist in resolving conflicts and reducing barriers are not adequate to meet the challenges posed by the emerging communication and information technologies. Furthermore, present U.S. policy appears to be treating technical assistance, technical information, and technology transfer to developing countries as separate rather than integrated issues.

Important questions include: What is the U.S. policy regarding the international transfer of computer technology and who is responsible for coordinating the implementation of that policy? How can telematics be applied to meet the development objectives Third-world nations have set for themselves? What new U.S. initiatives, if any, should be developed to support the export of microprocessing technology and related software and skills? Is the French effort to establish a world center for microcomputer science a model which the U.S. should support or emulate? Is a new

international mechanism necessary to raise and resolve the issues posed by rapid advances in telematics?

We will be interested to learn from Administration witnesses today their progress and future projections for assisting developing and developed countries in obtaining access to the international data market and in developing the infrastructure to creatively utilize the underlying technology.

Mr. GORE. At this point I would like to move right into the first panel. We are delighted to have representatives of two leading computer firms with us today. I would like to call to the witness table Mr. Ron Boring, developing countries program manager for the Apple Computer, Inc.; and Dr. Alan Kay, vice president and distinguished chief scientist of the Atari Co.

Gentlemen, we very much appreciate your attendance here this morning. We look forward to hearing from you.

Without objection, your prepared statements will be put into the record, and we will invite you to go ahead with your presentation. If you want to present highlights or the entire statement, we will leave that up to you, and then we will have questions for you.

Thank you for being here. We will begin with you, Mr. Boring.

STATEMENT OF RON BORING, DEVELOPING COUNTRIES PROGRAM MANAGER, APPLE COMPUTER, INC.

Mr. BORING. Good morning.

I am honored and pleased to have been invited to meet with you today to discuss questions centering on the transfer of microcomputer technology to the developing countries.

The topic you are beginning to explore is a timely one. The company with which I am associated, Apple Computer, Inc., is keenly aware that its products will have an impact on society. Indeed, we are consciously aiming to make a positive social contribution by designing and producing personal computers that eventually may become common yet powerful tools for a large number of people in the world. As a company, we have a great deal of confidence in the benefit this new technology can bring. However, it will produce changes in society. I do not believe anyone at Apple, or anywhere else for that matter, can say with much certainty what long-term effects this technology will have here or in the developing countries. Accordingly, we welcome the opportunity to begin this discussion with you and other concerned parties.

Before turning to the questions you sent us, I would like to convey the regrets of Steve Jobs, our board chairman, who was originally invited but could not attend because of other commitments. He is personally interested in this subject and wanted to be here. Hopefully, there will be another opportunity for him to share with you his thoughts and his vision of the future.

May I also say that because I am not Steve Jobs, I cannot speak with the authority he carries on matters pertaining directly to the policies and operations of Apple Computer, Inc. Therefore, I ask you to regard my remarks for what they are, opinions of an Apple employee who is involved in matters of market development in the developing countries but who is not speaking as an official spokesman for Apple Computer as a whole in all its activites.

These prepared remarks are purposefully brief. Instead of trying to write an extended and perhaps misleading answer to each of the

questions you posed, I chose instead to list several observations or speculations by way of response. In this way, I hope to provide some thoughts but allow more time to disucss them.

One, is it advisable or necessary for the United States to support the export of microcomputer technology to the developing countries?

It is important for first of all, to determine just what microcomputer technology we are speaking of. Are we referring to the design and manufacture of LSI chips or similar hardware components? Is it the production methods of simple manufacture and assembly we use in our factories? Is it software development, particularly application software? Or is in something else, perhaps some combination of all of these, or something beyond them?

I believe that when we ask questions about the transfer of microcomputer technlogy, as we are today, what we are reaching for has less to do with hardware and more to do with the impact that reliable, low-cost computing power will have when made available (at its conceptual extreme) to anyone, anywhere. The fundamental technology we are dealing with is a method of handling information; gathering, storing, analyzing, displaying, and communicating it. Microcomputers themselves, the hardware, are not the point nor is software, although that comes closer to it. Rather, it seems to me, the technology being transferred, dispersed if you will, is the very idea of computing * * * that there is something to be gained and little to fear in gathering and analyzing information, and the skills and tools are available for doing so. The transfer lies in instilling the values and methods of accessing and managing information. And this is essential if improvements are to be made in the quality of public policy and business decisionmaking, as well as individual manager productivity.

When seen in this light the term "technology transfer" takes on a somewhat different meaning than it generally carries when referring to heavy industrial, scientific, or similar transfers typically marked by binational negotiations, licensing agreements and the like. The case of Ford Motor Co. entering into an agreement to open a plant in Brazil comes to mind here. I think the term when used in reference to microcomputers is better understood by referring instead to such examples as the introduction of the bicycle, the transistor radio, the birth control pill, and the simple electronic calculator. These are items that after their initial development became simple, inexpensive and widely used technologies. People around the world saw their obvious usefulness and, in spite of the institutional resistance that always accompanies the introduction of any new technology, made them as common and inexpensive as to be for the most part taken for granted.

The more developed, industrial countries of the West are becoming more information based on some observers see this as the natural, next stage in the process of development, a characteristic of the post-industrial age. It is estimated that more than 70 percent of the U.S. gross national product is now derived from the information based service sector. One can hypothesize with some confidence, I think, that computer technology is providing the foundation, the means for this evolution, as well as reshaping our industrial and manufacturing technologies through the increasing use of

robotics, microcomputer-based control devices and the like. To the extent that the more developed countries are moving ahead in this direction, it may be an indication of just how much and in what way the developing countries are being left behind. Correspondingly, it also suggests a way by which the more developed countries could assist.

A key element, may I say a weakness, common to all sectoral approaches to development assistance is the lack of strong, local management capability. Whether we are speaking of attempts to increase agricultural output, improve education, raise health conditions, or strengthen economic planning, we soon reach a point where we must deal with specific projects that have specific objectives, budgets, time constraints, limited resources and decisions to be made under uncertainty. We are speaking then of the need for capable managers with practical tools for project planning, implementation and control. And here, I would assert, is where the developing countries are woefully short. There are simply not enough skilled managers to administer development programs and those who exist are doubly short on the kind of information needed to evaluate alternatives, monitor progress, and measures results.

I'll summarize my thoughts on this question by saying that the rapid expansion of the use of microcomputers is both the cause and the result of society's increased needs for information, in the developing countries as well as in our own. This trend is not likely to stop. The developing countries in particular have an urgent requirement for appropriate tools to raise the effectiveness of their comparatively thin layer of managerial capacity. Computer manufacturers will provide equipment, but the real transfer, the institutionalization of computing values and skills will be best accomplished through the training and example provided by international and binational assistance programs. In the developing countries microcomputer technology will make its largest contribution through the public sector. I believe it is the U.S. long-term national interest to assist that process.

Two, should such an effort be left to private enterprise, or should these programs continue to exist under the auspices of the United Nations and other international bodies?

It is unrealistic, in my view, even in this political season in Washington, to expect private enterprise to do what it is not established nor equipped for. Under our free enterprise system, the firm may have several goals. But profit maximization has to be a dominant one. Accordingly, with regard to the introduction of this technology to the developing countries, I believe we can expect the private sector to try to be attentive to the user's demands, to produce a good product, to distribute and support the product as best it can overseas, to respect international and local law, to be ethical in its business practices, and to actively cooperate with those who are trying to learn more about its technology and its uses. Private enterprise can go a long way, but it is not able to deal unilaterally with such things as the training of developing country officials, the installation of microcomputers in agricultural field research, designing of education programs or other applications. These are the tasks of the nations themselves, supported by the international aid agencies and rightly so.

The trend in our country is, and should be, I believe, toward greater public and private sector cooperation. The case facing us now, how to mutually assist in the responsible transfer of microcomputer technology to the developing countries, is a good example of this and an opportunity we should not ignore. I should add that besides the Government and private sectors, the academic community has much to offer here and should be included.

I believe microcomputer technology represents something the United States can be proud of. It was developed here, it is a positive, constructive new tool, and it will have far-reaching consequences. Accordingly, I believe U.S. agencies working in the developing countries should consider not only how they intend to handle the transfer question, for example, pass it on, but more important perhaps how they expect to incorporate it into their own program management and project activities. I believe U.S. agency officials, the academic community, developing country officials, and we manufacturers, could do much to explore the practical as well as theoretical aspects of this technology.

Three, what are the practical, scientific, political, and economic obstacles to such technology transfer?

For computing skills and values to take hold in a developing country, there have to be people on both sides who understand the technology. That is, there must be people who realize that what is being transferred is a new way of dealing with specific problems or decisions, not just computer hardware. There has to be an openness, a willingness to risk letting go of older ways of doing things, a capacity for adaptation. Further, there must be substantive problems to work on. The computer and its software are the means to an end, such as improved project management or higher literacy rates. The focus should be on the task's objectives and not on the tools or methodology one is using.

I suspect the introduction of microcomputer technology will face institutional resistance from those who, for whatever reason have a stake in guarding the existing distribution and use of information. Simplistically put, personal computers tend toward personal freedom and this may provoke an array of negative responses depending on the institutional environment. It will also provoke an interesting line of political and organizational questions.

There is a temptation to expect too much from the technology, of overselling it, of building an unrealistic idea of what it can do. The microcomputer is not magic and it is not a panacea. Researchers must still seek to ask the right questions and managers must still make decisions with what always seems to be insufficient data. That won't change. But the advantage of a simple, low-cost computer and the ability to use it can make those jobs easier and produce better results.

Some people will still fear the computer as they would any innovation, holding it as something they choose to distrust because they refuse to learn it. Some of these may also claim that computers displace people from jobs and therefore must be resisted, even though the comparative economic progress of Japan and Britain over the past 20 years would disprove that claim. Each of these two countries has followed a dramatically different policy with regard to

technological modernization, and though other factors obviously enter, the difference in results is striking.

In the end, my guess is that the technology will prevail against all obstacles as it becomes more powerful, easier to use, less expensive and more visible. but how to ease the path, how to foresee possible problems and work to reduce the short-term, negative effects of its development is our task now.

Thank you.

[The prepared statement of Mr. Boring follows:]

Testimony
of
Ron Boring
Program Manager
Apple Computer, Inc.

I am honored and pleased to have been invited to meet with you today to discuss questions centering on the transfer of microcomputer technology to the developing countries.

The topic you are beginning to explore is a timely one. The company with which I am associated, Apple Computer, Inc., is keenly aware that its products will have an impact on society. Indeed, we are consciously aiming to make a positive social contribution by designing and producing personal computers that eventually may become common yet powerful tools for a large number of people in the world. As a company, we have a great deal of confidence in the benefit this new technology can bring. However, it will produce changes in society. And I do not believe anyone at Apple, or anywhere else for that matter, can say with much certainty what long term effects this technology will have here or in the developing countries. Accordingly, we welcome the opportunity to begin this discussion with you and other concerned parties.

Before turning to the questions you sent us, I would like to convey the regrets of Steve Jobs, our board chairman, who was originally invited but could not attend because of other commitments. He is personally interested in this subject and wanted to be here. Hopefully, there will be another opportunity for him to share with you his thoughts and his vision of the future.

May I also say that because I am not Steve Jobs, I cannot speak with the authority he carries on matters pertaining directly to the policies and

operations of Apple Computer, Inc. Therefore, I ask you to regard my remarks for what they are, opinions of an Apple employee who is involved in matters of market development in the developing countries but who is not speaking as an official spokesman for Apple Computer as a whole in all its activities.

These prepared remarks are purposefully brief. Instead of trying to write an extended and perhaps misleading answer to each of the questions you posed, I chose instead to list several observations or speculations by way of response. In this way, I hope to provide some thoughts but allow more time to discuss them.

1. Is it advisable or necessary for the United States to support the export of microcomputer technology to the developing countries?

   - It is important for us first of all, to determine just what microcomputer technology we are speaking of. Are we referring to the design and manufacture of LSI chips or similar hardware components? Is it the production methods of simple manufacture and assembly we use in our factories? Is it software development, particularly application software? Or is it something else, perhaps some combination of all of these, or something beyond them?

   - I believe that when we ask questions about the transfer of microcomputer technology, as we are today, what we are reaching for has less to do with hardware and more to do with the impact that reliable, low cost computing power will have when made available (at its conceptual extreme) to anyone, anywhere. The fundamental technology we are dealing

with is a method of handling information; gathering, storing, analyzing, displaying and communicating it. Microcomputers themselves, the hardware, are not the point nor is software, although that comes closer to it. Rather, it seems to me, the technology being transferred, dispersed if you will, is the very idea of computing. . . that there is something to be gained and little to fear in gathering and analyzing information, and the skills and tools are available for doing so. The transfer lies in instilling the values and methods of accessing and managing information. And this is essential if improvements are to be made in the quality of public policy and business decision making, as well as individual manager productivity.

When seen in this light the term "technology transfer" takes on a somewhat different meaning than it generally carries when referring to heavy industrial, scientific, or similar transfers typically marked by bi-national negotiations, licensing agreements and the like. The case of Ford Motor Co. entering into an agreement to open a plant in Brazil comes to mind here. I think the term when used in reference to microcomputers is better understood by referring instead to such examples as the introduction of the bicycle, the transistor radio, the birth control pill, and the simple electronic calculator. These are items that after their initial development became simple, inexpensive and widely used technologies. People around the world saw their obvious usefulness and, in spite of the institutional resistance that always accompanies the introduction of any new technology, made them as common and inexpensive as to be for the most part taken for granted.

- The more developed, industrial countries of the West are becoming more information based and some observers see this as the natural, next stage in the process of development, a characteristic of the post industrial age. It is estimated that more than seventy percent of the US gross national product is now derived from the information based service sector. One can hypothisize with some confidence, I think, that computor technology is providing the foundation, the means for this evolution, as well as reshaping our industrial and manufacturing technologies through the increasing use of robotics, microcomputer-based control devices and the like. To the extent that the more developed countries are moving ahead in this direction, it may be an indication of just how much and in what way the developing countries are being left behind. Correspondingly, it also suggests a way by which the more developed countries could assist.

- A key element, may I say a weakness, common to all sectoral approaches to development assistance is the lack of strong, local management capability. Whether we are speaking of attempts to increase agricultural output, improve education, raise health conditions, or strengthen economic planning, we soon reach a point where we must deal with specific projects that have specific objectives, budgets, time constraints, limited resources and decisions to be made under uncertainty. We are speaking then of the need for capable managers with practical tools for project planning, implementation and control. And

here, I would assert, is where the developing countries are woefully short. There are simply not enough skilled managers to administer development programs and those who exist are doubly short on the kind of information needed to evaluate alternatives, monitor progress and measure results.

- I'll summarize my thoughts on this question by saying that the rapid expansion of the use of microcomputers is both the cause and the result of society's increased needs for information (in the developing countries as well as in our own). This trend is not likely to stop. The developing countries in particular have an urgent requirement for appropriate tools to raise the effectiveness of their comparatively thin layer of managerial capacity. Computer manufacturers will provide equipment, but the real "transfer", the institutionalization of computing values and skills will be best accomplished through the training and example provided by international and bi-national assistance programs. In the developing countries microcomputer technology will make its largest contribution through the public sector. I believe it is in the United States' long term national interest to asist that process.

2. Should such an effort be left to private enterprize, or should these programs continue to exist under the auspices of the UN and other international bodies?

- It is unrealistic, in my view, even in this political season in Washington, to expect private enterprize to do what it is not established nor equipped for. Under our free enterprize system, the firm may have

several goals. But profit maximization has to be a dominent one. Accordingly, with regard to the introduction of this technology to the developing countries, I believe we can expect the private sector to try to be attentive to the user's demands, to produce a good product, to distribute and support the product as best it can overseas, to respect international and local law, to be ethical in its business practices, and to actively cooperate with those who are trying to learn more about its technology and its uses. Private enterprize can go a long way, but it is not able to deal unilaterally with such things as the training of developing country officials, the installation of microcomputers in agricultural field research, designing of education programs or other applications. These are the tasks of the nations themselves, supported by the international aid agencies and rightly so.

- The trend in our country is, and should be I believe, toward greater public and private sector cooperation. The case facing us now, how to mutually assist in the responsible transfer of microcomputer technology to the developing countries, is a good example of this and an opportunity we should not ignore. I should add that besides the government and private sectors, the academic community has much to offer here and should be included.

- I believe microcomputer technology represents something the United States can be proud of. It was developed here, it is a positive, constructive new tool, and it will have far reaching consequences. Accordingly, I believe US agencies working in the developing countries should consider

not only how they intend to handle the transfer question, e.g. pass it on, but more importantly perhaps how they expect to incorporate it into their own program management and project activities. I believe US agency officials, the academic community, developing country officials, and we manufacturers, could do much more to explore the practical as well as theoretical aspects of this technology.

3. What are the practical, scientific, political and economic obstacles to such technology transfer?

- For computing skills and values to take hold in a developing country, there have to be people on both sides who understand the technology. That is, there must be people who realize that what is being transferred is a new way of dealing with specific problems or decisions, not just computer hardware. There has to be an openness, a willingness to risk letting go of older ways of doing things, a capacity for adaptation. Further, there must be substantive problems to work on. The computer and its software are the means to an end, such as improved project management or higher literacy rates. The focus should be on the task's objectives and not on the tools or methodology one is using.=

- I suspect the introduction of microcomputer technology will face institutional resistance from those who, for whatever reason have a stake in guarding the existing distribution and use of information. Simplistically put, personal computers tend toward personal freedom and this may provoke an array of negative responses depending on the institutional environment. It will also provoke an interesting line of

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In the end, my guess is that the technology will prevail against all obstacles as it becomes more powerful, easier to use, less expensive and more visible. But how to ease the path, how to foresee possible problems and work to reduce the short term negative effects of its development is our task now.

Mr. GORE. Thank you very much for an excellent presentation. We will hold questions until Dr. Kay has completed his statement—Dr. Alan Kay, chief scientist for Atari.

Welcome, Dr. Kay.

STATEMENT OF DR. ALAN KAY, VICE PRESIDENT/CHIEF SCIENTIST, ATARI, INC.

Dr. KAY. Thank you.

I have made a fairly short statement, as I prefer to answer questions; I think that may be more fruitful, especially since many of my remarks echo those of Mr. Servan-Schreiber and the group that you had here in May.

To quote from Mr. Servan-Schreiber's testimony in May, "What is at stake is not a humanitarian dream but a fundamental responsibility and a challenging opportunity." It was this rather pragmatic bent that attracted me to the Group de Paris and led to my participation in the design of the Centre and the writing of its charter with Papert and Servan-Schreiber. I did this before I went to Atari last summer.

Early on, assisted especially by Dr. Ayensu and Mr. W. T. Gallwey, we came to some important conclusions about the nature of our effort. First, technology transfer was not a helpful metaphor, as it suggests that technology, and often also education, is a kind of fluid that can be transferred from a teacher vessel to a student vessel.

Instead, we believe that technology and learning are processes requiring continuous immersion. Most transfer projects to the developing nations have had less success than was hoped for. In fact, in typical American firms, it is not trivial matter just to get a prototype from research to engineering to manufacturing if the relevant people have not been continuously involved in the process.

So we just feel that the notion of transfer is not a fruitful one. That is not what happens. That is not the strong mechanism for doing this.

Thus, the main strategy of the Centre turned away from the idea of sending missionaries with Bibles already written to convert the heathen. Rather, we wanted to do the equivalent of taking paper and printing presses to other cultures saying:

> There exists this wonderful medium for expressing ideas to others in a way that helps them learn. If you would like to participate, you must do most of the work yourselves, because you understand what your culture needs, and we don't. However, we can help you work out an orthography for your language if you don't have one, and perhaps there are a few things about learning we might be able to contribute.

For various reasons, to be discussed shortly, we chose personal computers instead of paper as the medium we wish to introduce. Otherwise, the processes in which we hope to involve other cultures are the same.

In short, the object of the Centre Mondial is to seed culture-directed projects that can employ the remarkable learning magnification of personal computers in the most powerful fashion.

Little is known about learning, and doubtless it has many forms. Much interesting learning takes place simply when one's attention is focused and self-interference is low. Therefore, one way to pro-

mote learning without having to understand it very well is to create conditions which hold and focus attention and which bypass self-doubt.

Much still needs to be done, but this much is clear: Personal computers, especially those that will be available in a few years, provide by far the best all-around environment for the twin processes of attention grabbing coupled with the kind of close reaction to human probing that facilitates learning and understanding.

One of the concerns of your committee is to determine how much involvement the U.S. Government should have in programs of this kind. I do think the United States should have great interest in these affairs, not just abroad but at home also.

Yet we should not feel that nothing is currently being done except by the French and the Japanese. For example, my own company, Atari, by year's end will have given away more than a half million dollars worth of equipment to catalyze learning through computers. Recipients include: The Capitol Children's Museum here in Washington, which serves the disadvantaged; an Atari computer camp, also in the Washington inner city; a barrio in Austin, Tex., in a project devoted to bilingual education; New Mexico Indians; and more. Other American companies have similar programs.

Governor Brown of California became interested in the Centre through conversations with Servan-Schreiber, Papert, and me, and turned this interest into a $4.2-million program to set up 19 demonstration computer learning centers throughout the State.

Although things are happening, what is needed is a concerted national awareness and effort to greatly intensify seeding programs. I believe that the United States should take to heart Servan-Schreiber's and France's notion of the Centre Mondial as the first of many international organizations and join with France and Japan to create one or more American centers to be part of this critical network. This area of concern is more important and pressing than many grand projects that have excited the national interest, such as the space program, since it literally is a major key on a planetary scale to the success or failure of the rest of this century.

Thank you.

[The prepared statement of Dr. Kay follows:]

STATEMENT OF DR. ALAN KAY

Thank you for your invitation to testify about the transfer of micro-processing and information technologies to developing nations and to comment on the Centre Mondial of M. Servan-Schreiber and colleagues in Paris.

To quote from M. Servan-Schreiber's testimony: "What is at stake is not a humanitarian dream but a fundamental responsibility and a challenging opportunity". It was this rather pragmatic bent that attracted me to the Group de Paris and led to my participation in the design of the Centre and the writing of its charter.

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Thus, the main strategy of the Centre turned away from the idea of sending missionaries with Bibles already written to "convert the heathen". Rather, we wanted to do the equivalent of taking paper and printing presses to other cultures saying." There exists this wonderful medium for expressing ideas to others in a way that helps them learn. If you would like to participate you must do most of the work yourselves because you understand what your culture needs and we don't. However, we can help you work out an orthography for your language if you don't have one, and perhaps there are a few things about learning we might be able to contribute".

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Little is known about learning, and doubtless it has many forms. Much interesting learning takes place simply when one's attention is focused and self-interference is low. Therefore, one way to promote learning without having to understand it very well is to create conditions which hold and focus attention and which bypass self-doubt.

Much still needs to be done, but this much is clear: Personal Computers, especially those that will be available in a few years, provide by far the best all-around environment for the twin processes of attention-grabbing coupled with the kind of close reaction to human probing that facilitates learning and understanding.

One of the concerns of your committee is to determine how much involvement the U.S. Government should have in programs of this kind. I do think the U.S. should have great interest in these affairs not just abroad but at home also. Yet we should not feel that nothing is currently being done except by the French and the Japanese.

For example, my own company Atari by years end will have given away more than half a million dollars worth of equipment to catalyse learning through computers. Recipients include: the Capitol Children's Museum here in Washington which serves the disadvantaged, an Atari computer camp in the Washington inner-city, the barrio in Austin, Texas in a project devoted to bi-lingual education, the New Mexico Indians, and more. Other American companies have similar programs.

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Though things are happening, what is needed is a concerted national awareness and effort to greatly intensify seeding programs. I believe that the U.S. should take to heart Servan-Scheiber's and France's notion of the Centre Mondial as the first of many international organizations and join with France and Japan to create one or more American centers to be part of this critical network. This area of concern is more important and pressing than many grand projects that have excited the national interest (such as the space program) since it literally is a major key to the success or failure of the rest of this century on a planetary scale.

Mr. GORE. Thank you very much.

Let me ask you first of all, Dr. Kay: You participated in the startup phase of the World Center. You then left the World Center; is that correct?

Dr. KAY. No; it was not a world center when I worked on it. I had already gone to Atari by the time Mitterrand proclaimed it in November. So I worked on the World Center for 6 or 7 months or so in a period when I was on sabbatical from Xerox Research Center.

Mr. GORE. The thrust of my next question was going to be why you did not stay associated with it, and I take it that your reasons were other than some conclusions about its viability.

Dr. KAY. No; in fact I think all of us were somewhere between surprised and flabbergasted that the stuff we had done in the summer got turned so quickly into an organization.

My choice to go to Atari was an independent thought. I went to Atari because that was the best place for me; that was where I wanted to go, of all the places I could choose from. The involvement with a company that is on an international scale, as I have, really precludes me from being on the board of the Centre. Of course almost everybody there is a friend of mine, and there is an electronic mail network that connects most scientists throughout the world, so every day or so I get messages from them and hear what they are doing.

So I am certainly connected in the communications sense, but I have no official tie with the Centre at all.

Mr. GORE. Do you think they will succeed?

Dr. KAY. In order to succeed, you first have to attempt, and they are still working their way up to their first attempt.

I think that if they keep to the original plan—and I must say that the French have this way of doing things on a monumental scale; the Japanese have a more subtle approach. In November, when the French Centre was announced, the Japanese announced that they were going to open one but not until 1985, a rather sensible approach, because that is actually how long it takes to set up one of these.

So the French are basically operating in a goldfish bowl, and it will essentially be up to them not to try too hard to succeed early. If they do that, and they stick to the plan of trying to understand what the actual situation is in seeding projects in countries, then they have a reasonable chance to amass the kind of knowledge necessary to actually carry it one step further.

I do not see this as a single grand plan having a single strategy but as something which is almost in the nature of a research project of trying to understand not so much why transfer projects of the past have not succeeded—I think we will all admit that they have been pretty much of a dismal failure—but really to try to understand what is the process of getting individual cultures themselves involved, because that is the driving force in anything. That is really the secret, I think, of education in this country: Once you get the student involved in the process of his own education, the teacher is now just a resource rather than the key figure.

Mr. GORE. I take it that you share the motivating vision of those who organized the World Centre and that you believe that the technology of computers, and microcomputers particularly, is qualitatively different in its likely impact on civilization than almost any technology that has been created in the past.

Dr. KAY. Yes. I do not think it will have any more impact than writing and paper.

Mr. GORE. It is on that scale, though.

Dr. KAY. It is on that scale.

Mr. GORE. It is on a scale with the invention of the printing press.

Dr. KAY. Yes.

Mr. GORE. When you get to that realization, then there are two forks. There is the fork in the road, the idealistic motivation which says that the problems of the world threaten to overwhelm us; there is mass starvation, accelerating violence, and so forth, and so

on; this is an opportunity to solve these problems; let us get this technology out into the world so it can be used.

Then there is the pragmatic business development approach that says this is likely to be the largest market for things to be sold in the history of mankind, and the World Centre takes the initial realization, and both of those paths, and says let us explore just exactly how this emerging technology can be applied in countries around the world, including the poorest and most undeveloped countries, so that the problems can be addressed and so that this market will be developed.

As you say, the French have done this on a grand scale and have attracted people of extremely high caliber from this country to go and work on it. The Japanese have taken a more cautious, methodical approach, announcing that they are going to do the same thing but are going to lay the groundwork and spring it in 1985.

I have not heard any announcement in the United States at all.

The focus of this hearing really is to explore what the United States should think about. Should we say this does not call for a focused effort in the United States? We do not need to do what the French are doing and what the Japanese are doing. Maybe that is the answer, but I do not want this time to pass without people here in the United States, in this industry, and in the relevant government institutions, thinking about what the French are up to, what the Japanese are up to, what it is that they have seen and are responding to, and just to think about the fact: Are we missing the boat? Should we have some goal alinement in this country with respect to either the effort to solve these problems or the tremendous market that is out there being developed?

If the answer is no, that is not our style, we should not attack the problem in that way, OK, that is fine; at least we thought about it.

If the answer is, maybe we should have a national effort of some kind, then we have got some more work to do.

Let me just ask you both to comment on that.

Dr. KAY. Let me try to do it with three quick points. Printing was initially viewed as a solution to the problem of distributing religious tracts. In fact, what happened is that it almost destroyed religion as it was known up to that time. This is a sort of McLuhanesque kind of point, but it is a very important one.

I do not agree, although I understand the use of the word "tool." A tool is something that constrains some of the degrees of freedom of a medium in order to manipulate the other ones better, and the computer is no tool in that sense; it is the ultimate medium, because its content is other media. The tools are the programs that are written for it, to constrain it one way or another.

Because of that, we have to treat this not as a tool, not as a new kind of hammer or even a gun, but as something as world-shaking as paper and printing have been. It will literally change the fabric of society in ways we cannot predict, and I believe the genii is out of the bottle, as far as worrying about controlling it is concerned; it is uncontrolled right now; it is just going to happen. I think the best thing we can do is to make our arks and ride with it.

Another point is whether we should worry about it. If we only worry about one thing, we should worry about doing this to our-

selves. That is, if we think that this technology can help the Third World, then we have to think, can it help the educational system in America?

It is really true that education does not require computers to be good. There is absolutely no doubt about that. But it may be the situation in this country that we can only get back on a track of reasonable education with something new.

Mr. GORE. Let me interject there to say that I felt the place to start was right here in this institution, in the Congress, and I want to thank you for your help in designing the computer literacy course for Members of Congress several months ago. Several of my colleagues and I enjoyed it.

I agree with you that we have got to address the problems here in the United States.

Dr. KAY. I think the final thing is whether we should have a national effort. We have to remember that the basic problem with the space program was that they forgot just one thing, and that was to invent space travel. We did get to the Moon, but we did not get space travel out of that effort.

The objective was so narrow that it could be solved without solving the general problem in an interesting way, and therefore our ability to deal with space exploration is about where it was before Sputnik.

We can send up a *Columbia* every once in a while to a space station, but as far as going to Mars is concerned, that is as far away as it has ever been.

So my suggestion is that in frenzied national efforts we try and actually solve some interesting problem rather than some cardboard one.

I have been a science fiction reader all my life; I grew up on it. There was nothing more ho-hum than the final landing on the Moon, because nothing really interesting had been accomplished.

Mr. GORE. These walls are shaking. [Laughter.]

Dr. KAY. As the president of the University of Utah pointed out years ago—and he had been a former Director of NASA—the really interesting thing about the space program was that it was one of the first times in history $24 billion and 300,000 people had actually been combined to achieve a single goal.

The organizational parts of NASA and the spinoff science parts to NASA were interesting, but did they invent space travel? Heck, no.

So I would say that if we are going to get involved in a national effort to do something about education—and this is not the first time this has been talked about—I would think that we would try to get away from the tendency of almost all educators when they are in trouble to start defining behavioral objectives, as though we actually know something about learning and what people should know, but instead try and simply facilitate whatever processes are latent in people.

As Tim Galway points out, it is fortunate that we do not have to learn how to walk and talk in school. If we did, there would be quite a few more crippled people.

Perhaps the fact that learning happens in spite of our institutions—we should actually try to find a way to magnify and funnel the ability of human creatures to learn.

I spent quite a few years trying to understand the processes of learning. Most of the theories and most of the things we are able to come up with are rather uninteresting as far as deciding what to do next is concerned.

When I started studying interference removal, looking at it the other way—suppose learning just happens, maybe we could make it better, but if we do not understand how—but if there is interference there that can actually be removed by focusing people's attentions in a much harder, much longer fashion, as can be done with computers, and learning happens better that way, well, why not?

It did not make me feel bad that we did not have a good theory for learning; maybe a good theory for interference removal will take us the next step of the way.

Mr. GORE. Thank you very much.

I have taken too much time, but Mr. Boring, I would like you to respond to my question.

Mr. BORING. Your question seemed to have two parts as I heard it. One part had to do with the fact that we are at a point where there is an opportunity to use this technology for development assistance on the one hand, but yet on the other, if we are not careful about this, we might lose something that might bring us national profit——

Mr. GORE. No, no, no. First, are the Japanese and the French correct in foreseeing this enormous impending change—the rapid spread of microcomputer technology throughout the world? Are they correct in seeing that?

Second, if they are, is there something the United States ought to do to have its hand in that emerging market and emerging effort to solve the world's problems simultaneously?

Mr. BORING. Alright. My response would be something like this: Yes, the genii is out of the bottle; there is no turning back on this now. This technology is fundamentally different. It will expand and rapidly change, and we do not know exactly what it is going to do. It represents tremendous powers and tremendous opportunities.

Thus, we who know something of the technology must try to address the questions of how it can specifically help developing countries. It seems to me that it is in the interest of the United States to deal with that question, because if that is not handled, I am reasonably convinced that we will have problems within our lifetime in this world.

The second part is, to what extent does this have something to do with being a U.S. industry? Actually, that is an aspect that I am not too worried about. I think that U.S. industries can and will compete sucessfuly and will expand. I have some confidence on that.

But regarding the first part of your question, the more specific issue is how to respond governmentally.

It seems to me that symbols are important. The Centre Mondiale represents a symbol of an activity. I have a hunch that it will also become eventually muscle-bound with bureaucracy. Institutions often do, whenever you institutionalize an idea of this kind. But

that aside, it is still a very useful symbol, so I am all for it. I don't think we need to have our own, but we could collaborate with them or replicate some portion of it. Its existence is important although I do not think the U.S. should put a tremendous amount of money or effort into such an institution or think that the center itself is the goal.

I think what we do need to do is to think small, to think incrementally. And that has more to do with, as Alan is pointing out, how do we get this into schools? How do we get it into offices here? How do we begin to crack the problems of learning how to use it, of learning how to adapt it to our own systems.

In a sense, I am suggesting doing two things. Let us avoid creating a giant institution, that yields very little change. Instead, let's seek a more modest organizational form for its symbolic value and ability to help us learn to adopt the technology to the things we actually do, the ways we actually work.

Mr. GORE. Thank you very much.

Doug Walgren is cochairing these hearings.

Mr. WALGREN. Thank you, Mr. Chairman.

I understand you have entered into the record the statement that represents the initial interests of the Subcommittee on Science, Research, and Technology, and we certainly are interested in following this area. I think it is important that a body as pivotal in our society as the U.S. Congress express its interest and focus, as Mr. Gore has pointed out, the attention of those in our society that may have something to contribute in this area on these questions. If we do not, we perhaps may be behind a world revolution that, as you say, has great dimension.

I want to try to ask you to be a little bit more specific in what the possibilities of our involvement would be. We talk about education. It is my understanding that we have at least a small effort in educational theory and the like through the National Science Foundation and some other institutions in our society.

But we say the genie is out of the bottle and we have to ride the boat that we are in. I guess what I would like to ask is, How do we make that boat do the most constructive things? I gather from both of you using that analogy that you agree we must have a vehicle—some kind of joint effort. What goes into that? What goes into the making of that boat? What is the structure of the ark? How do you put the oars in the water? Does it have a rudder?

We want to think small and think incrementally. That is useful, and maybe it is true, you do not want to go on a frenzied national effort. On the other hand, maybe the microcomputer would not even exist were it not for that frenzied $24 billion effort.

How do we as a society take hold of this and go forward with it? Does the Government have any role at all?

Dr. KAY. I have not seen anything in this country that the Government does not have a role in. I mean, the Government is something that is part of everything that we do.

Mr. WALGREN. If you recall, Ronald Reagan does not quite believe that.

Dr. KAY. Well, Washington still exists in spite of that.

Mr. WALGREN. It is being taken apart in large pertinent part. [Laughter.]

I really do not believe you can assume there is a consensus for Government activity in this country, and if there is a revolution the size of the printing press coming along, there is absolutely no guarantee that this society will be anywhere near it.

Dr. KAY. There have been several kinds of Government research over the last 20 years, and it is sort of interesting to contrast the different styles. You mentioned NSF, which was put together in response to another challenge that we perceived.

But we also have had for 20 years Advanced Research Projects Agency funding. Particularly, many of the most interesting developments in computers have been funded by ARPA in the public domain, including timesharing, computer graphics, higher level programing languages, and so forth.

The contrasting styles of research give you different kinds of yield. Research funding that is tied to a congressional cycle tends to want to have crisp answers and good results. There was even a joke years ago that when you applied for an NSF grant you had done your research the year before, so you could guarantee that your next year's results would be exactly as you described them in the proposal.

There is a tendency to be a little conservative looking at it that way. Whereas the ARPA funding, especially in the golden age of the late 1960's, was essentially a shotgun approach taking percentages. They funded people rather than projects and were willing to take their lumps. And they got quite a number of good things out of that way of doing things.

So I am not suggesting that the United States should go to high-risk funding as its single strategy, but I basically think that the problem with Government funding of research is that not enough high-risk funding is done in this country, and especially now.

After Vietnam soured things, the Government funding of high-risk research has essentially never recovered in my view. That is critical.

It is very difficult, also, inside of companies, to withhold about 40 percent of hip-pocket money to do things that really have very little chance of success. Actually, the company I am part of right now—its parent company is part of the entertainment industry, and they make movies. Movies have this annoying habit of only being successful every once in a while, but people keep on making movies. They pay for the ones that do not work with the ones that do, and they keep on going.

That is a much stronger model for how research should be done than trying to build some sort of suspension bridge that many cars are going to go over, where you just do not want the thing to fail at all, ever.

So my feeling is that one of the things to do is, if we are going to have this computer medium, first, to make it the best medium we possibly can. Right now, it is sort of where paper was before they had invented rollers. It is kind of like felt now. We are trying to impress information into it, and the information is held in a somewhat useful but not a very artistic form.

There are many generations. Of course, generations only take a couple of years, so it will not be too long before many new things will be able to be done.

But one of the things that the Government could do that I think is critical is to make our computer medium the best information-carrying technology that we possibly can. That way, it becomes much more neutral and much more useful. You do not see the cracks and all of the glitches in it that much that way.

I think the other thing that can be done is this. The Government, with a fairly small amount of outlay, could set up a satellite center for the World Center and the Japanese center.

The whole thrust of the French proposal has been that the Centre in Paris is simply the first of a truly international group of centers devoted to trying to find out more about this problem.

Every time somebody says let us solve the problem—and we will know the French have gone astray when they start saying, we are trying to solve the problem, or, we are solving the problem—but if they say, we are finding out more about the problem, then I think we are in pretty good shape.

The other thing is that we have time on our side. We talked about the seizing of computers on board ships, which to me is absolutely ridiculous. Almost anybody who wants to can come and take a course in our American universities, and I can tell you that there is almost nothing important about either making chips or designing them that you cannot learn in a university.

At Stanford as a student, or at Cal-Tech as a student, you can do absolute state-of-the-art chip design and research

Mr. GORE. You might be able to, Dr. Kay.

Dr. KAY. No. I am saying "a student." The Japanese have sent plenty of students over, and they have learned a lot, as they will be the first to say so.

The Russians are not all that stupid. If I were a Russian, what I would do is go and enroll myself in Stanford and go through their chip design course in 4 years, and I could go back and set up a production line. What I would not be that interested in doing is hijacking a boatload of computers, because you learn very little by looking at all that crystallized sand in there.

That is not very interesting, but actually learning how to do the things, which is really quite easy—this is, I think, the hardest thing to explain to people, because the technology seems to be miraculous, but I can tell you, it is basically easier than making steel.

I had this very interesting antitechnology reaction from a friend of mine who is quite a good designer. He was very proud of having designed the heat engine for being used in the Third World. It was made out of scrap metal. When we started talking about personal computers to him, he got incensed at impressing this high technology stuff on the Third World. I said to him, "Where did your scrap metal come from? You grew up in a world in which there is scrap metal lying all over it. That scrap metal had to be fixed by bacteria in order to get the iron ore. There is a limited amount of it, whereas the Earth is largely sand, the material from which this stuff is made."

The actual things that have to be understood to make silicon crystals and silicon chips and do programing are rather small in number. We just have to realize that this is not a technology that is a high technology; it is actually a rather cottage-level technology.

Mr. WALGREN. Let me ask your colleague, if I might, if he could describe any of the details of the ship that you think they are on?

Mr. BORING. I do not know if I can describe the ship, but let me respond to your question as I see it: What is it that the Government might do? What is it that you might be thinking about recommending or passing on?

Mr. WALGREN. What should this society do?

Mr. BORING. OK. I have two observations first and then maybe some ideas.

First, I suspect that the French must be considering this same question right now. Now that they have the Centre, they must be asking themselves: What direction to take? If you have a very broad goal or idea, how do you make it specific? They have the Centre and rent to pay but the same question. You my be ahead of the game on that point.

Second, I want to comment on something said before. That is, I do not see this as a high-risk venture. These are not major investments. Installing or expanding the use of microcomputers does not require much money. In fact, this is cheap, and it is going to get cheaper in comparison to other technologies. So significant Government support can be achieved with comparatively modest funds.

Accordingly, I would be thinking of a couple of possibilities, following the earlier idea. First, I would try to establish a visual leadership, symbolic leadership. I would authorize an agency or identify a responsible group to address the issues, to coordinate with other international agencies, to look at questions of satellite placement, networking, technical standards and othr issues that must be worked out in the future.

I would also hope that there would be clearer national leadership. Someone said that one of the reasons the Centre was established in France was that leadership was there: Mitterrand had taken this on as a personal thing. I think that demonstrated commitment is invaluable.

More specifically I would try to free up the agencies that are attempting to work with this now. The Government agencies that are dealing internationally have internal questions now that I am not completely familiar with, but certainly they need to be addressed.

There are Government officials using their own microcomputers, because they see that this is a very practical tool in their work. Yet the purchasing officer does not pay for it or makes it difficult to pay for it. So you have that classic centralization-decentralization problem that happens in all organizations: who buys? Is it worth buying? That sort of thing. How do you control the data? How do you secure it? Can you take those diskettes home and work on them? It could be that the entire country's program's budget is right there on that diskette. You have those kinds of management issues.

These are management issues within the agencies. Officials could be given some guidelines and support. It is the clearing up of this kind of bureaucratic hindrance and letting happen what will very likely happen anyway that would free the way to gain more public experience in the field .

I think also that some modest investments in research are needed. I understand that one of the things that the World Center

is doing is an education project going on in Senegal. I am not familiar with it, but my guess is they are using Logo or something like Logo. Logo is a program; it is a language that is designed to let the user think systematically about programing. It is not the computer, but a way of thinking. Interacting with the computer with this particular program lets people who perhaps do not have high literacy rates or other skills begin to think in a different way. That is an exciting idea, and I am sure the project requires only a very modest level of investment. It is a very practical kind of activity. Spinoffs are known that could be replicated.

There are other kinds of education programs and training programs.

I suppose if you are trying to assist private sector development in this country there would be tax incentives of various kinds. There are already business deductions, I am sure, but perhaps there is more that could be done on that score; I do not know. Those are some things that come to my mind.

Mr. WALGREN. I yield to the gentleman from California, Mr. Brown.

Mr. BROWN. Gentlemen, I appreciate your testimony very much about the importance of this subject.

Let me suggest a model to you and ask you to comment on it. For one thing, this Subcommittee on Science, Research, and Technology has been grappling with a draft of institution structure for a national capability in this area for 2 or 3 years. We had legislation introduced on it in the last session in the form of a National Institute for Information Systems, Policy, and Analysis, which could be a model, although we had a problem with that grandiose title.

I want to ask you to comment on whether something of that sort might be appropriate. It has the mechanism for public-private cooperation and focuses on national strategies and goals.

Then I want to suggest some other models that were provoked by your phrase, Mr. Boring, about thinking small and thinking incrementally. We have a highly developed data processing computer system in a wide variety of areas in this country: agriculture, health, and education. We have the capability, for example, to put a Plato computer, I suppose, in a microprocessor—much simplified, I suppose—and to give perhaps each underdeveloped country a university. And there might be a market for that—for access to fundamental knowledge in a computer around the world.

We have a network of international agricultural research organizations, each of which needs access to the world's data base in agriculture. Most of these are in underdeveloped countries.

Speaking incrementally, these existing agriculture research institutions could become a basis for expanding computer-base operations and related things and provide for the expansion of this new knowledge into that part of the world.

We suddenly have this highly developed health system that the whole world is tied into: The National Institutes of Health computer or health library. We could make that kind of thing available to countries.

Would we be making a contribution by focusing on the replication at a simplified level for the underdeveloped world of capabili-

ties we already have here, and looking at it from a global market point of view?

Mr. BORING. I have a couple of notions on how we organize this. First of all, the idea of having large data bases in this country with transmission links to terminals in other countries—allowing access to the data base here so that someone could call in, take a look at agricultural statistics perhaps gathered worldwide, or economic forecasts and the like—is a fine opportunity. There is nothing wrong with the idea, but let me pose a couple of cautions.

The first is that one could argue that this centralization of information is another example of the dependency theory problem. That is, people in developing countries are subject to data bases held in this country and perhaps the data they need locally have not gotten here yet and may not get here. So they are at the end of the line at a terminal, located far away and we are still dealing with the practical and conceptual problem of the large computer idea.

The conceptual change of the microcomputer is that it offers one computer to one person. That person is controling it.

Mr. BROWN. I would agree with you. What I was suggesting was connecting the nodes and then have them connected to the microcomputers.

Mr. BORING. And I agree, there is nothing wrong with that. But when you are talking about microcomputer power, you are talking about the power to have that kind of data storage-retrieval analytical, communicating, display capability right there. That is a fundamental change.

In the case of Plato for example, the educational program is very good, but it takes quite a while to design that kind of program and it's expensive. It may be far better, far cheaper to design education and training programs locally using the people most directly connected with the substantive materials. For example, imagine you are at an agricultural research institute, an irrigation engineer, and you have designed an irrigation model. Now you want to train some people on how to use it: You want to see it implemented. You have got to train several hundred local field agents in several different countries. You need a very quick, effective training vehicle. And you know your subject better than anyone else.

It might be better in this case if, with the aid of a microcomputer—which you have already been using to develop your models—a videotape machine, and a program to drive the videotape device for you to design, film, that and diseminate your own training program, in your own language, uniquely suited to your audience. The solution is problem oriented. And you have just saved a tremendous amount of money.

Mr. GORE. We have a vote on the urgent supplemental. When we come back, we will continue.

[Recess taken.]

Mr. BROWN [acting chairman]. Chairman Gore will be back very shortly, but in the meantime, in order to expedite the proceedings, he asked me to go ahead.

We were discussing the question of models or a mechanism by which we might help to achieve this dissemination of microcomputer technology around the world. Would you like to continue?

Mr. BORING. Surely. Mr. Brown, there is no question about the advantage to having access to large data banks. I simply want to emphasize another advantage that comes with having a microcomputer, and that is that you are able to do the research that you want to do and control your own data there where you are.

You mentioned agricultural research and the international agriculture institutes. The experience there, which has come out of several recent conferences is that the comparative advantage of the microcomputer in the field is that it is able to provide the researcher an opportunity to do a first cut at verifying the quality of his findings.

In the past, if someone had been gathering data on sorghum trials for example, and they have many plots of sorghum growing under different conditions, and are testing maybe 20 different variables against so many different varieties, they have the problem of many different variables to observe. Further, they may have untrained numerators—people who go out to count and measure. In the past, researchers have had to carry this voluminous data back, not only to the capital city, but perhaps as far as Michigan State, Paris, or somewhere else to be analyzed.

This may take several months, and then they may find out that it is no good; the numbers do not match; something is wrong. Instead, what they are able to do now with a microcomputer is to make that first analysis in the field, substantially improving the quality of the research effort.

Mr. BROWN. I am trying to visualize—and I think the committee is interested in visualizing—how we go about the process of involving ourselves in this great job of bringing the world into this computer age; it is not a very easy task.

There is a very interesting conference going on here in Washington this week, the Sixth Conference on the Use of Computers in Chemistry in Research and Education. It is an international conference; there are people from all over the world. Chemistry has probably pioneered amongst the sciences in the use of computers for a wide range of important scientific activity.

My thought—sort of thinking along these lines—has been that we take the base of expertise that we have, and we build and expand on it, and we take some responsibility for exploring as a society and as a government how we can do this in meeting vital needs of the societies that we are concerned about—our own first and the rest of the world.

We do not seem to have the capability to focus on this as an interesting problem in the terms that you use. I am wondering where we are going to get that capability. Is private enterprise separately or collectively going to have a capability to analyze global needs, shall we say, in such a fashion that they would be able to assist in focusing the resources of society, both in the developed and the underdeveloped world, on the critical areas of need?

Obviously, the World Center was developed in part to do that job, I presume. Is that right?

Dr. KAY. I agree more with the spirit of your remarks actually than the tactics behind them. I will give you a couple of quick anecdotes.

A friend of mine was in the Peace Corps in Nepal teaching science. Early on, he picked a leaf off a tree and took it into the classroom and starting talking about it. After about 10 minutes, he realized that nobody knew what he was talking about.

After much questioning, he discovered that when he detached the leaf from the tree, it had changed its name, and every other important thing about it had change, because the Nepalese basically do not have shape and color as important sorting parameters in their society. The real big ones were that it was alive and now it was dead, and it was an essential part of this tree, and it was something completely else after it had been detached.

Their world view is different. The idea that they would be able to use our data bases directly or use our books, I think, would not work out.

In New York City you can go up into Harlem and find some pretty good libraries that nobody goes into. Books are pretty good. I used to give a talk about this high technology thing that had been invented long ago called basic organization of knowledge. It has all these wonderful things. You can random access millions of characters and be OK. We have got libraries and networks full of these things, but not everybody we would like to have read them does.

So it is not a question of actually taking all this wonderful stuff over. That is why I think the transfer notion is not as strong as we really want it to be. I do not think Plato would fly in very many of the countries at all; the world view is so different.

We know that in management information systems from the famous study by IBM if the managers in the corporation do not design some part of the management information system, they will not use it, and that is in this country.

There is a famous story of Schumacher in "Small is Beautiful" about the transportation of heavy tractors into India. In our theory of agriculture, we use tractors and so on. It turned out that the ground was very hard, so they imported bigger and bigger tractors in order to plow through this ground. It did not work very well. Finally, somebody invented a little gadget that was like a plow that had a one-horsepower motor on it. What they did was drive a spike at the end of the field and unreeled this rope, and they started this little plow with a one-horsepower motor reeling in this rope, and it dragged the plow through the ground—infinitely more efficient than all of our heavy tractors, because our tractors were never designed for that kind of terrain, and the people who went there initially did not bother to try and look at what the parameters of the problem were.

So the feeling of the people who are designing the World Center is that what we really wanted to do was at least start from ground zero and not try to make too many assumptions, except probably, as Fitzgerald said, the rich are somehow different; they have more money than we do. Because we have chosen to call the Third World the "Third World" we are implicitly saying that somehow they are different from us; they are in a different stage of development. There is no reason why we should suspect that anything that works in this country—and most of those things do not even work in this country—should work in the Third World.

But to go the other way, I disagree—let us say I agree more strongly that personal computers do not mean stand-alone computers. In fact, I think I was the culprit who actually made up that term long ago—15 or more years ago. The vision then, as it has always been, is that computers are communications devices. You communicate with yourself and with others through them. A computer without a network is a very drab thing indeed. It is like being able to write letters without having a post office.

One of the secondary plans of the Centre, but one that is extremely difficult to do, is on how to get some of the things that are worthwhile knowing in the world, that could be delivered through networks, in a forum that actually would be amenable to different cultures.

We talked of the "Encyclopedia Brittanica." What does it take to actually translate general knowledge of the encyclopedia kind into another culture. It is no trivial matter. It is not a matter of simply translating. You have to get people who actually understand the subject matter on both sides and can actually retransform all the metaphors that are there. And the idea of doing that for several hundred countries on a world data base is absolutely staggering.

I should mention that there are some other technical ways of doing it that are more feasible than the translation problem.

My feeling is yes, we have all of these things to offer, but we cannot offer them in the form that we can use them. What we really have to offer is a transportation mechanism for this kind of knowledge that, if the cultures are willing to work on their ends, can allow something to flow.

Mr. BROWN. Gentlemen, thank you very much for your testimony this morning. I regret that we have been delayed and interrupted, but you have certainly provided us with a lot of provocative insight. Thank you.

Dr. KAY. Thank you.

Mr. BORING. Thank you.

Mr. BROWN. We are going to take up next, as a panel, the following people, who, we understand, have time pressures: Mr. Kalmann Schaefer, special assistant to the chairman for international affairs of the FCC; Mr. Curt Farrar, Assistant Administrator for Research of AID; and Mr. Jim Phillips, director, Office of Communications and UNESCO at the Department of State.

Would you folks come forward?

Mr. Phillips, would you like to start?

Again, I apologize for the delay in getting you up here this morning. I hope we can move along expeditiously.

STATEMENT OF JAMES D. PHILLIPS, DIRECTOR, OFFICE OF COMMUNICATIONS AND UNESCO AFFAIRS, BUREAU OF INTERNATIONAL ORGANIZATION AFFAIRS, DEPARTMENT OF STATE

Mr. PHILLIPS. Thank you very much, Mr. Chairman. I want to thank you and the other members of the joint subcommittees for giving me this opportunity to make some remarks this morning.

When Chairman Gore noted the focus of this hearing, it occurred to me that we may need a rather wide-lens camera to bring me into the picture, because I am very far removed from high technol-

ogy of any kind. My concern in the State Deparment, is with the ideological or political aspects of communications transfer.

I have put my thoughts in a statement which is available to you and the other members of the committee, and I will try to summarize what I think my special perspective can bring to your hearing.

Mr. BROWN. Without objection, your statement will be inserted in the record.

Mr. PHILLIPS. Many of you on the committee are aware of a debate that has been going on for some time within UNESCO and other international organizations about a so-called New World Information Order—a New International Information and Communications Order, to be precise. This is a concept that was introduced by certain Third World countries as a means of redressing what they regard as a serious imbalance in both their capabilities to communicate and the kind of communications that they receive in their countries, and perhaps equally important, the image of themselves as presented in our media in the West—particularly the United States.

As you may know, some 85 percent of the information that flows internationally—I am talking about news—is provided by four major international news agencies, UP, AP, Reuters, and Agence France Presse.

The complaint that began to develop rather seriously about 10 or 15 years ago, and which finally came to a head in the UNESCO forum, was that the Third World was disadvantaged in both the kind of information it received from the West and in the image of the Third World that was presented to us. By example, they said, "All you ever cover is earthquakes, disasters, famines, and so on, in our countries, and yet we know more about your congressional elections than we do about our own." This complaint was very familiar.

There is a legitimate basis for that complaint. Anybody who has studied the situation with any objectivity will recognize that their complaints are, in some cases, very well founded.

However, the debate was muddied, I think, and distorted by efforts on the part of Soviet bloc countries and some of the more radical Third World countries to exploit the debate for their own purposes—in other words, to introduce into international arenas a concept of the press and the media which was their own, which was the Communist bloc's notion of the press at the service of the state rather than the press as an independent critic or gadfly of society.

This ran counter to our own ideological and political interests. It had some appeal to even moderate Third World countries who were seeking a way to escape from what they regarded as domination by the multinational corporations which, in their view, controled the news.

This debate has raged on back and forth in many fora, but particularly in UNESCO over the last few years.

The United States made a proposal in 1980, which has had some success, and which may be relevant when you think of models of how to transfer technology to the Third World.

From our point of view, a solution would be to form some sort of institution within UNESCO which could look at the practical prob-

lems of the Third World and try to match the needs of the Third World with the capabilities of the western developed countries.

The institution that was formed is called the IPDC, the International Program for Communications Development. It has had two meetings, one in Paris and one in Acapulco, and the 36 member states that are on the executive board of the IPDC have been successful in three ways:

One, this forum has served to diffuse to a certain extent the ideological wrangling that has always surrounded the issue of free flow of information.

Two, although in a very primitive way, beginnings were made in developing a list of Third World needs, as they are perceived in the communications sector.

At Acapulco a number of projects were approved by the IPDC board—given a sort of stamp of approval—so that western countries who wished to be supportive of their goals could choose projects that they cared to support and try and support them.

Three, it focused the attention of the West on legitimate needs, and both in this country and in other western industrialized countries government and private sector responses to those needs are being formed in a rather encouraging fashion.

At Acapulco, the United States was able to announce that AID had set aside $100,000, which is seed money and a modest beginning, for communication development. We felt at that time that we should not give the money directly to UNESCO or to the IPDC but, rather, that we should use our funds bilaterally in support of projects which we could support wholeheartedly, and while we have not as yet picked such a project, there are several promising ones under consideration, one particularly in Kenya that is under close study at this time.

At the same time, we encourage the development of a private sector organization in the United States, which is looking at communication development needs in the Third World, and seeing what contribution can be made from the purely private sector.

So we did achieve our basic goals at the first two meetings of the IPDC, but for the United States to be able to continue successfully in that forum, we are going to have to address in a serious way the concerns that the Third World countries expressed about their own communications development.

There is a sort of tradeoff that has occurred; that is, as long as the IPDC seems to be functioning, the moderate, overwhelming majority of Third World countries have tacitly agreed to let it proceed without reintroducing a number of the very objectionable aspects of the so-called new international communications and information order that are fraught with problems and difficulties for the United States and the western industrialized countries. These are normative proposals that have surfaced mainly in UNESCO, such as licensing journalists, adopting an international code of ethics for journalists, and other things which, however innocuously worded, bear the seeds of the ability of countries around the world to stifle the free press. We have opposed them.

The administration took a very strong stand when it looked at this issue. We have been assertive in UNESCO and in other international fora, and we have argued that our first amendment values

simply are not negotiable; they are not something that we can see diluted in any way, nor can we be party to any organization or institution which is attempting to do so on an international basis.

We did propose the alternative of looking seriously at nonideological real world needs in the communications sectors of the Third World, and so far this approach has paid off in that the ideological debate and the rhetoric that is used in discussing the New World information order has diminished somewhat in our view.

We will not let our guard down. We will continue to oppose any measures that would infringe on the free flow of information and free press values, but we would also like very much to continue, in the IPDC and other appropriate fora, a serious effort at cataloging communication needs in the Third World and seeing how the public and private sectors in the United States could work together to help meet some of those needs.

Thank you very much.

[The prepared statement of Mr. Phillips follows:]

STATEMENT BY JAMES D. PHILLIPS, DIRECTOR, OFFICE OF COMMUNICATIONS AND UNESCO AFFAIRS, BUREAU OF INTERNATIONAL ORGANIZATION AFFAIRS, DEPARTMENT OF STATE

I want to thank the Chairmen of the Subcommittee on Investigations and Oversight and the Subcommittee on Science and Technology for the opportunity to testify today.

Let me begin by clarifying my areas of responsibility. Within the Department of State, I am the Office Director for Communications and UNESCO Affairs in the Bureau of International Organizations. I have no technical background, and will therefore not be able to discuss technical aspects of micro processing and information technology transfer. My concern is with the ideological debate within UNESCO and other international organizations on international communications policies and, in particular, the political and economic implications of such policies for the United States.

Many of you are aware of the debate within UNESCO about a "New International Information and Communications Order." (NICO). For some years, third world countries have complained about an imbalance in the flow of news they receive from the industrialized countries, as well as the image presented in the western media of their countries and societies. It is difficult in this debate to sort out legitimate concerns and aspirations from exaggerations and unfounded fears as third world countries look at the technical prowess of the western media. But the difficulty has been compounded many times by the insertion of ideological red herrings and propaganda attacks on the West by the Soviet bloc and its radical third world allies.

Largely due to this latter influence within UNESCO, we have been faced with porposals to "protect" journalists on international assignments, to establish an international code of ethics for journalists, to assure a so-called "balanced flow" of information by setting international standards and norms, and with other related proposals which would lead, in our view, to serious restrictions on the free flow of information across national boundaries. Moreover, in looking carefully at the often innocuously worded proposals, it is clear that many would lead to serious restrictions on the media within countries, and on the free flow of non-proprietary information. For example, a dictatorship that wished to stifle the press could use an international code of ethics against journalists who refused to hew the party line; other states could point to such a code as providing international sanctions for media restrictions already in place. It takes little imagination to conceive of many other abuses that could flow from a number of the proposals made in the name of a NICO.

For these reasons, this administration decided early on to take the offensive in the debate, to dispel any possible doubt about this country's deep commitment to its first amendment values. We have made it clear through our Delegation in Paris and at international meetings on communications issues around the world that we will oppose any measures which, in our judgment, would restrict the free flow of information. To underscore this commitment, the President gave his personal support to a proposal introduced by Representative Robin Beard last year which calls for a cut

off of U.S. funding to UNESCO should any measures be adopted by or through UNESCO which result in media restrictions.

In developing our policies on these issues, we have worked closely with concerned Americans from the private sector representing groups such as the World Press Freedom Committee, the American Newspaper Publishers Association, the American Bar Association, the Inter-American Press Association and many others. We believe our efforts have been at least partially successful; UNESCO officials, from Director-General M'Bow on down, are fully aware of the strength and unity of U.S. views on these issues. Our adversaries now see the U.S. resolve to oppose anti-free press initiatives as a formidable barrier to reshaping international information policies to their ideological liking.

At the same time, we understand the concern of many Third World countries about technological disparities in communications capabilities. These countries are determined to build up their communications sectors, and we can fully support them in their efforts. In fact, we have argued consistently that the way to achieve a better balance of information flow around the world is not to tear down or restrict Western capabilities, but to build up capabilities in the Third World.

It is for this reason that we have supported the International Program for the Development of Communications (IPDC) within UNESCO. The IPDC has a 36-member executive council that provides a useful forum for attempting to match Third World needs and Western capabilities. It was our belief when we supported the concept that an IPDC could help UNESCO escape from sterile ideological debate by focussing on real world needs and capabilities. This hope has so far been realized. At the second meeting of the IPDC at Acapulco in January of 1982, a number of projects were approved involving assistance to Third World media. At our urging, it was decided not to restrict support to a central fund controlled by UNESCO to finance projects. Instead, any member state wishing to support IPDC activities would have several avenues to do so, including bilateral programs. The United States has decided to support the IPDC through strictly bilateral arrangements. At Acapulco the U.S. announced that AID has set aside $100,000 for communication development projects. A specific project for this funding has not as yet been identified, but several interesting proposals are under serious consideration.

Over and above AID's bilateral activities, there is a role for the U.S. private media in helping to meet legitimate Third World communication needs through the IPDC. We strongly believe that the private sector can play an important part in this endeavor.

I would like to point out that no IPDC projects involving microprocessing on computers have been considered at this stage. Most IPDC projects call for more mundane assistance such as training journalists, supplying equipment and exchanging technical information, although one IPDC project now in the feasibility study phase proposes the exchange of news and television programs via satellite among African countries.

We are convinced that expanding and modernizing communication systems in developing countries can create a market for the sale of advanced communications equipment. As early as April 15, 1978, as an example, "Editor and Publisher" magazine reported that American computer-editing equipment was being installed in newspapers in South America. There will surely be similar technological advances elsewhere. Thus we believe the United States and the West can benefit in real economic terms, as well as politically, from supporting legitimate Third World communications aspirations.

Mr. Chairman, I am happy to report that we have noted some changes for the better in the UNESCO Secretariat's approach to communication issues. Several meetintgs on NICO proposals scheduled under UNESCO auspices, which we strongly opposed, have been indefinitely postponed or thoroughly revised. The rhetoric within UNESCO has become relatively more moderate than it was several years ago; no restrictive measures have been adopted; moderate Third World countries appear to welcome the more pragmatic approach to their problems in the IPDC, as opposed to the bombast and confrontation that marked earlier UNESCO discussions of their concerns.

These are positive signs, but only signs. Many UNESCO member states remain adamantly opposed to the values of a free press and to Western leadership in the communications and information fields. They will continue to press their ideas and proposals and will take advantage of any sign that we are letting down our guard. I would like to close, therefore, by assuring you that the State Department will continue to oppose any efforts to curtail our basic free press values; that our commitment to the free flow of news, ideas and cultural products is not subject to negotiations or compromise.

Thank you.

BIOGRAPHICAL SKETCH OF JAMES DANIEL PHILLIPS

James D. Phillips was born in 1933 in Peoria, Illinois, but moved with his family to Wichita, Kansas, where he attended primary school. He graduated from the Holy Cross Abbey School in Canyon City, Colorado, and has a BA and MA degree from the University of Kansas at Wichita. Mr. Phillips completed a year of study at the University of Vienna in Vienna, Austria, and three years of graduate school at Cornell University. He completed all the requirements for a Ph. D. degree at Cornell except the dissertation. He is a member of Phi Beta Kappa and the Honorary Political Science fraternity.

Mr. Phillips served in the U.S. Army from 1953 to 1955.

In 1961 Mr. Phillips entered the Foreign Service and has served in France, Zaire, Luxembourg and The Gambia as well as in the Department of State in Washington. Mr. Phillips has also served as a Foreign Service Inspector and participated in the inspection of Embassy Saigon and the CORDS Program in 1970.

In 1980 he served as a political advisor and member of the U.S. Delegation to the UN Conference on Women in Copenhagen, Denmark. From 1980–81 Mr. Phillips was a student at the National War College in Washington, D.C. He took up his duties as Office Director for Communications and UNESCO Affairs in the Bureau of International Organization Affairs in July 1981.

Mr. Phillips speaks French and German.

Mr. GORE. Thank you for a very fine statement.

We will hear now from Mr. Curt Farrar, Deputy Assistant Administrator for Research, with the Agency for International Development.

Mr. Farrar, welcome.

STATEMENT OF CURT FARRAR, DEPUTY ASSISTANT ADMINISTRATOR FOR RESEARCH, AGENCY FOR INTERNATIONAL DEVELOPMENT

Mr. FARRAR. Thank you very much, Mr. Chairman.

I too would like to express my appreciation on behalf of AID for having the opportunity to discuss this important question with you and to have heard the other witnesses and their ideas.

I also have a statement that has been made available to the committee. I will summarize a few of the main points in it.

Mr. GORE. Without objection, we will put the whole thing in and let you summarize, if you wish.

Mr. FARRAR. The main point that I want to stress is that AID, over the past several years, has found the microcomputer to be a very valuable instrument for a lot of different purposes. It is clearly relevant to what we are trying to do, and we have been accumulating quite a lot of experience with its use in various kinds of development programs.

Some of you will know that there are four main policy ideas that the Agency has put forward in recent years. One is to encourage developing countries to adopt national policies that will promote efficient long-term growth with equity. In this regard microcomputers are proving to be very valuable both to recipient governments and to ourselves in analyzing policy alternatives.

Another of our policy objectives is to work for an enhanced role of the private sector, both in the United States and in developing countries, to help in achieving our development goals.

Of course, as we have heard, U.S. private enterprise is supplying both the hardware and the software that enable microcomputers to extend and improve the capacity of developing country institutions.

In addition we expect that in developing countries the small computer will play the same kind of role in enhancing opportunities for private business that it plays in this country.

Another policy objective is the expansion of human and institutional capacities in developing countries. The potential role of the small computer for management and information systems will be very important in that area as well.

A final objective is the application of science and technology to the needs of developing countries, an area in which I work most of the time. Microcomputers are precisely that—a technology that is currently available and can be applied in many ways in the developing countries.

I think the most important contribution that microcomputers make to development will be increased accessibility to substantial computational and analytical power. Where the data and analytical skills exist and where there is a demand for improved analysis, microcomputers provide the potential for substantially improved analysis and planning capacity in development institutions and, perhaps even more important, permit substantial decentralization of this computing power. In many instances, microcomputers represent a more appropriate tool and level of computing power than conventional, larger-scale technologies.

A second major contribution is increased access to information.

A third is the speed with which they manipulate information. Data collected in the field can be entered directly on a computer and verified in the field. Those of us who have had experience with the delays of getting financial reports out of development projects—just to take a very mundane example—know that microcomputers could make a major contribution in making financial reports more timely.

A fourth long-term, potential contribution is in training, analysis, and planning. Here we have the computer working interactively with video disks or cassettes as an important new educational technology. While we recognize that the microcomputer cannot substitute for insight and judgment as an analytical tool, it certainly can enhance those qualities where they exist in developing countries.

The final contribution I would mention is the microcomputer's modular character—the fact that it is small, self-contained, can be combined with other devices in a whole variety of ways, and while independent of a large central system can be linked up when appropriate.

Our experience has also brought us to the point where we have identified a number of constraints on the use of microcomputers in development. Perhaps the most immediate constraint is unreliable electric power. This is a problem that can be solved technologically. In addition to existing voltage regulators and other devices in the future. Instruments can perhaps either be made less sensitive to variations in electricity or given more independent power sources. While the microcomputer is a lot easier to handle in that regard than the larger computers, it is a problem to which we continue to seek new, more cost-effective solutions.

Most of our AID contractors and overseas staff have been able to deal with the repair situation because of their good linkages back to the United States.

Looking into the future, I think that problems in maintaining microcomputers will grow as the number of units grows. So far our own suppliers of hardware have been relatively slow to expand their maintenance capacity to work overseas. Again, it seems to be a problem that can be, but has not yet been, dealt with.

A more complex issue is microcomputer training and institutionalization of microcomputer use. Very often a microcomputer will be built into a project to solve a particular problem and then be left without adequate attention. We need to think about long-term use, training people in its use, and the institutional structure in which the computer can be more fully used. We are aware of this problem, and we expect to pay more attention to it in the future.

Another serious problem to which I have no real suggested answer is the problem of LDC concerns about the flow of information across borders. Developing countries are very sensitive to this question and will be even more sensitive if foreigners in their countries have microcomputers and their nationals and country institutions do not.

There are a number of specific instances in which we have used computers—the analysis of policy alternatives in the field of population; the use of satellite data for land resource analysis; communication networks among the scattered campuses of a particular university; and agricultural planning and data collection. My statement lists other uses.

As I have suggested, the rapid expansion of microcomputer use in AID projects has not been a matter of deliberate policy but of pragmatic judgment. The micro has simply proved to be a good tool for a wide variety of jobs.

Our experience to date shows that it is a very valuable tool. To take greater advantage of it, we need to encourage greater communication among users in development-related activities so that we can identify problems and needed research; encourage the dissemination of lessons learned; and promote greater coordination and improvement of our technical backstopping of field projects.

We have identified five roles that we think AID needs to play in this area. First, we can help introduce microcomputers in ways that can stimulate long-term changes in productivity. For example, we see immediate improvements in budgeting in our pilot project with the Ministry of Agriculture in Kenya.

Second, we can encourage research and development on computer applications. We could probably do this by funding experimental introductions of microcomputers for promising uses and assuring that feedback from these experiments reaches manufacturers and software development specialists who can then use this information.

Third, we can play an active role in stimulating the exchange of information among users.

Fourth, we can assist in overcoming logistical problems by using our expertise in this area, and we can draw the attention of manufacturers to mechanical problems that arise in developing countries

and try to work with them in solving them and marketing the solutions.

Fifth, we can provide LDC users with realistic expectations for both hardware and software. If we can assist in matching the right tool to the right job, we will be helping with the rational expansion of this technology.

The U.S. private sector has built up great momentum in the field of microcomputers based on creative innovations in both software and hardware. Unlike agriculture, where great breakthroughs have taken place in universities and the international agricultural research centers, to which Chairman Brown referred earlier, innovation in the microcomputer field has centered in the high-technology, private sector and in consulting firms that adapt the technology for specific clientele.

We think AID can complement the efforts of the private sector by encouraging research and development on the problems of adapting hardware and software to LDC needs and by facilitating the appropriate application of the new technologies in our development projects. This will greatly facilitate the mobilization of private resources and private initiatives to assist developing countries in acquiring access to the information revolution.

I will stop there, Mr. Chairman. I will be glad to answer any questions you may have.

[The prepared statement of Mr. Farrar follows:]

STATEMENT OF CURTIS FARRAR, DEPUTY ASSISTANT ADMINISTRATOR FOR RESEARCH, BUREAU OF SCIENCE AND TECHNOLOGY, AGENCY FOR INTERNATIONAL DEVELOPMENT

INTRODUCTION

On behalf of the Agency for International Development, I would like to thank the Committee for this opportunity to share with you our thoughts and experiences with microcomputers in the developing nations.

As you know, the Agency for International Development (A.I.D.) is charged with administering U.S. programs of economic assistance to developing countries, both those financed with development assistance, whose main purpose is the long term economic growth of developing countries in a pattern of equity, and those where more immediate foreign policy purposes are linked with economic support.

Some of the principal policy directions of A.I.D., each of which is directly relevant to computer applications, are the following:

1. To encourage developing countries to adopt national policies which will promote efficient, long-term growth with equity. Such policies are critical not only if development goals are to be achieved, but also if effective use is to be made of foreign assistance. Microcomputers are providing valuable to recipient governments and to us in analyzing policy alternatives.

2. to work for an enhanced role of the private sector, both in the United States and in the developing countries, as one of the principal sources of economic progress. U.S. private enterprise supplies both the hardware and the software that enable microcomputers to expand and improve the capacity of developing country institutions; the small computer will undoubtedly come to play an important role in improving the management of and promoting the growth of small businesses in the LDCs as it is already playing here in the United States.

3. To support the expansion of human and institutional capacities in developing countries as a major element in economic progress in LDC's. The potential role of the small computer for strengthening the management and information systems is the same in LDC's as it is elsewhere.

4. Finally, A.I.D. emphasizes the application of science and technology to the needs of developing countries. A major focus of A.I.D. programs today is the application of new scientific discoveries and new technology to solving the problems of developing countries. For example, we are looking forward to applications of new biotechnology in the areas of health, agriculture, and energy to meet developing coun-

try needs—A.I.D. is sponsoring a conference with the National Academy of Sciences this month to bring together LDC and U.S. scientists working in this area to develop an action agenda. Microcomputers, the subject of this Committee's concern, are another promising new technology.

In this brief discussion, I plan to talk about the role of microcomputers in development, and some of the constraints on their use, to mention a few specific applications from among the many in A.I.D. supported development programs, and to look at some of the issues which A.I.D. faces in ensuring wise and efficient use in the future of this powerful technology.

MICROCOMPUTERS IN DEVELOPMENT

The most important contribution that microcomputers will make to development will be the increased accessibility they provide to substantial computational and analytical power. They are relatively cheap. They do not require sophisticated programming training. Their computational power and versatility is increasing every year. Where the data and analytical skills exist and where there is a demand for improved analysis, they provide the potential for substantially improved analytical and planning capacity in development institutions. More important, the micro permits substantial decentralization of this computing power to the field.

A second important contribution will be increased access to information. Because microcomputers provide a compact and efficient way to store and process information, they provide ready access to filed material. Experiments in the U.S. in teaching with micros (using video presentations and an interactive mode with the user) indicate that they are a very "lively" method of presenting information. A.I.D.'s experience with the RAPID project, which I shall describe later, indicates the effectiveness of microcomputers for presenting population projections and their impact on development to senior decision makers in LDC's. It has been suggested that it may be feasible to make a library of information available even at the village level using this technology.

A third contribution is the speed with which microcomputers can manipulate information. Field data can be entered directly onto computer disks and verified in the field. Cash flow and expenditures can be completed in minutes when previously it took days. Managers can quickly simulate the impact of alternative decisions or of various estimates of error. If microcomputers were used for no other purpose but financial management applications of this kind, they could still reduce one of the most commonly encountered implementation problems in development projects.

A fourth application is in training, analysis and planning. The simulation capacity of the microcomputer, in combination with its accessibility and interactive capacity, greatly assists problem solving. The machine encourages the user to experiment with alternative formulations, solutions, or configurations of the problem. It does this at relatively little cost in time or energy. The microcomputer cannot substitute for insight and judgement, but it can certainly assist these qualities where they exist.

A fifth characteristic of the microcomputer which makes it especially suitable for LDC use is its modular character. The microcomputer is small and self-contained and so we are able to fit it into almost any computer infrastructure we find in developing countries. In addition, we are able to add any number of different peripheral devices to the micro, and each can stand alone by itself (as opposed to tacking peripherals onto a mainframe), or be used in conjunction. The microcomputer can be thought of as a disaggregated general purpose system and provide the developing countries the flexibility of applying computer power to a wide range of development problems not possible with a large mainframe computer.

A list of microcomputer uses recently developed for a National Academy of Sciences conference on microcomputer in development is attached in Annex A. This illustrates the potential versatility of these machines.

CONSTRAINTS

The single most common problem raised by practitioners regarding computer transfer to developing countries is unreliable electrical power. This is probably a short term problem providing the needed investments are made to make the machines less sensitive to electrical variations. In any case micros are less sensitive to an unfavorable environment than mainframe computers and in case of damage the loss is far less.

Repairs have been a problem but most A.I.D. contractors have been able to deal with the situation because they have good links to service and support systems in the U.S. As the machines begin to spread, maintenance problems can be expected to

grow. On the other hand, hardware suppliers are slowly expanding their overseas operations and can be expected to deal with this problem eventually.

Training and "institutionalization" of the machine have been a problem in some donor projects. The reason for this is that the purpose of the project has seldom been to transfer microcomputer technology. Rather, the machine was brought in to do a job. A.I.D. is aware of this problem and plans, where appropriate, to incorporate the provision of training services in its projects.

The availability of software adapted for development needs has been a constraint. There is a particular lack of software in local languages.

A more serious problem is related to LDC concerns about the flow of information across borders. LDCs have long been sensitive to the flight of research data generated in their countries. If LDC institutions lack microcomputer facilities while foreign researchers increasingly employ this technology, the flight of data issue will become even more serious.

Microcomputers also provide individuals with easy access to stored data and easy reproduction of data files on small disks. This has raised questions about the "leakage" of sensitive or even restricted data that developing countries might wish to keep under control. At the moment microcomputers have little capacity to protect data stored on disks. It is difficult to see any satisfactory or generally applicable solution to this problem at this time.

A.I.D. EXPERIENCE WITH MICROCOMPUTERS

A few examples of A.I.D.-sponsored microcomputer applications may be helpful in illustrating the versatility we have already experienced with this technology. A partial list of other applications by the Agency is attached (Annex B).

Policy planning—population

The A.I.D.-funded Resources for Awareness of Population Impact on Development project (RAPID) demonstrated that microcomputer technology has remarkable potential in helping decision-makers in developing countries to make their own analyses of problems which require policy changes. The RAPID approach enables leaders in developing countries to visualize the impacts of different population growth scenarios on their ability to achieve their social and economic development goals. The presentation illustrates the effect of different growth rates on the demand for such things as health services, teachers, classrooms, new jobs, food, land, etc. By putting their own assumptions into a projection model developed for A.I.D. by the Futures Group, these decision-makers can begin to grasp more fully the problems likely to be associated with unchecked population growth and to examine alternatives which might alter the scenarios displayed. So far the equipment has been transferred to over a dozen LDC's where it continues to be used in presentations and for further demographic and planning analysis.

A similar approach to policy-relevant problem analysis is being developed now to portray the impact of deforestation. Tests are underway in Thailand and Upper Volta, two seriously deforested countries.

Natural resource management

In cooperation with the Government of Sri Lanka, A.I.D. has developed a hardware and software system to interpret satellite and aircraft image data (Remote Sensing for Resource Assessment Project). Using this microcomputer-based system, color maps of land use, area measurements of land use, and interpretations of these land use data can be produced. The system fits on a desk top and can be installed and operated with the minimum of specialized training. A.I.D. funded the development of the system and the Government of Sri Lanka and two weeks of training in its operation and maintenance.

Under the Remote Sensing for Agriculture project A.I.D. has funded the purchase, transportation, and installation of microprocessors to assist in the tabulation and analysis of agricultural statistics. The objective of this project is to enhance agricultural planning capability in LDC's. Using "land use themes" or land use maps developed from satellite and aircraft imagery, sample areas are selected for the collection of agricultural data (crops, areas, yields). The microcomputer is used to store, tabulate, and derive national estimates for various statistics through the automatic application of the ratio of the sample field areas to total land use area. Turnaround time in data processing and efficiency in the sample selection procedure are greatly improved with the use of the micro technology. Microcomputers will be installed in Jamaica, Ecuador, Morocco, Tunisia, Sierra Leone, and Sudan.

Information and communication networks—education

At the University of the South Pacific, microcomputers have been used for the past three years to link the widely scattered campuses of the university. The ATS-1 satellite has provided the heart of the network with funding from the A.I.D. Rural Satellite project. The application so far has been for administrative purposes such as record-keeping, instantaneous information retrieval, and electronic mail. Further applications of this kind are planned for the University of the West Indies and for Indonesia. The combination of satellite and microcomputer is particularly suitable for these scattered island institutions.

Project management—agriculture

The use of microcomputers in agriculture is particularly promising. In the United States many thousands of microcomputers are already being used by individual farmers and agribusinesses. Successful agriculture requires detailed knowledge of local factors and circumstances, and prompt response to conditions of the growing cycle. Microcomputers at local levels can help project managers and extension workers to organize information and respond promptly to farmers' needs and to make improvements in agriculture project management.

Microcomputers have been used quite successfully by Purdue University agricultural researchers to gather and process data on farm level management and production in remote sites in Mali, Upper Volta, and Niger. The ability to do this initial processing in the field close to the data source, as opposed to sending the data to capital cities to be processed centrally, has meant better data quality, and faster processing. In addition, the environmental conditions found at the remote sites would not have supported a mainframe computer which demands controlled temperature and humidity.

Management and budgeting—agriculture

A Science and Technology Bureau grant to explore the application of microcomputers to food management systems has provided the Kenyan Ministry of Agriculture with a microcomputer as a management and budgeting aid. In addition to its use in the food management area, it is, now, also being used by the finance and budgeting divisions in the Ministry. The machine, with technical assistance provided by A.I.D., was used extensively in the recent recalculation of the Ministry budget which was necessitated by the IMF negotiations. More importantly, the possibilities opened up by this budgeting experience have led to a shift from quarterly to monthly financial reporting. This should lead to a substantial improvement in the Ministry's cash flow analysis. The microcomputer contributed to improved budgeting by providing easy access to data and speed and accuracy of calculations. Ministry staff were able to use the machine without extensive training or programming skills and using commercially available hardware and software. The benefits to improved financial management were evident within a few months. The Kenya pilot project will be continued with World Bank funding which will provide six microcomputers.

THE EVOLVING A.I.D. ROLE

The rapid role of microcomputer use in A.I.D. projects has not been a matter of deliberate policy but of pragmatic judgement—the micro was simply the best tool for the job. Individual contractors—who provide much of A.I.D.-financed technical assistance—and individual A.I.D. staff, have seized on the tool to facilitate project operations. Most of these have been routine applications such as financial management or traditional computer tasks such as data analysis. But individual researchers have also experimented with new applications of microcomputers such as computer assisted instruction, or where microcomputers permit a decentralization of information and decision to field offices and provide a speed of management response not previously possible.

A.I.D.'s experience to date shows that this is an extremely valuable development tool. To facilitate its further use, we need to encourage greater communication among users so that we can identify problems and needed research, encourage the dissemination of lessons learned, promote greater coordination, and improve our technical backstopping of field projects.

A.I.D. has five important roles to play in the transfer of microcomputer technology to developing countries.

First, A.I.D. can help to introduce microcomputers in ways which can stimulate long-term changes in productivity. By linking microcomputer use to project functions and by ensuring that services and software are available, A.I.D. can improve the potential that micros will become part of the normal analysis and management

procedures in developing countries and that their users will be more efficient analysts and managers in the future. We have seen immediate improvements in budgeting in our pilot project with the Kenya Ministry of Agriculture, for example.

Second, A.I.D. can encourage R & D in computer applications. The development of both hardware and software especially suited to development needs (e.g., improved data based management) can be fostered by funding experimental introductions of microcomputers for promising uses and by ensuring that feedback on those experiments reaches manufacturers and software development specialists.

Third, A.I.D. can play a more active role in facilitating the flow of information among users. A.I.D. already supports a number of networks for information exchange. These have proved useful means for getting new knowledge out to a wider group of interested professionals. An information "clearinghouse" geared to micro users might be an attractive new network. Such an externally-managed network can be supplemented by improved in-house communication. New software must be tested and results disseminated to potential users if greater redundancy in software development is to be avoided.

Fourth, A.I.D. can assist in overcoming logistical problems by using its long expertise in this area and can draw the attention of manufacturers to the mechanical problems which arise in developing countries. Microcomputer manufacturers have been slow to improve the machines' tolerance of unreliable electrical power, for example, although this is often cited as the major constraint to micro use in developing countries. Maintenance has also continued to be a problem and must be dealt with if greater use of micros is to be encouraged.

Fifth, A.I.D. can help to provide LDC users with realistic expectations for both the hardware and software available. Such an explosive technology is replete with false starts and unrealistic expectations. Mistakes can be painful and costly. If A.I.D. can assist in matching the right tool to the right job we can contribute to the rational expansion of the technology.

The United States private sector has built up great momentum in the field of microcomputers based on creative innovations in both software and hardware. Unlike agriculture where the great breakthroughs have taken place in the universities and the international agricultural research centers, innovation in the microcomputer field has been centered in the high-technology private sector and consulting firms that adapt the technology for specific clientele. We believe that A.I.D. can complement the efforts of the private sector by encouraging R & D on the problems of adapting hardware and software to LDC needs and by facilitating the appropriate application of the new technologies in our development projects. This will greatly facilitate the mobilization of private resources and private initiative to assist developing countries in acquiring access to the information revolution.

CONCLUSIONS

A.I.D. is already substantially involved in the use of microcomputers as a development tool. We expect these uses to expand rapidly. In order to guide that expansion we face several tasks.

First, there is need for continued work on a sector-specific basis to realize the potential of the new technology. Second, we need to come to terms with the problems associated with the transfer of this technology. In this connection we need to improve communication within A.I.D. and with other agencies. Third, we can make an immediate and important contribution in removing some of the constraints on effective microcomputer use in developing countries—logistics, software, etc.

A.I.D. will certainly welcome cooperation with other donors on the sharing of information and will collaborate on specific problems of mutual concern. We are working already with other U.S. government agencies, including the Bureau of the Census, the Department of Agriculture and NASA, on microcomputer applications.

A.I.D. does not believe that microcomputers are the answer to the world's ills. Our approach will, therefore, be a pragmatic one—where the microcomputer can increase efficiency, we will use it. We intend to build on a solid base of known and tried applications, developing specific microcomputer solutions to specific problems. In consequence, we expect our work to continue to be sector focused as we build appropriate microcomputer applications into a package of technical inputs into each sector. We will encourage the use of microcomputers when this will help to get the job done better than other methods.

ANNEX A.—SECTORAL APPLICATIONS OF MICROCOMPUTERS

A. AGRICULTURE AND FOOD

(1) Analysis of soils, weather, etc.; (2) Historical data such as growing conditions, crop yields; (3) Communication systems for extension services; (4) Nutritional information; (5) Market reports; (6) Biometrical analysis; (7) Inventory of food supplies and storage facilities; and (8) Agro-climatic information systems.

B. HEALTH

(1) Communication systems for emergency health care delivery; (2) Patient records; (3) Health clinic data storage systems; (4) Morbidity and mortality statistical analysis; (5) Epidemiology analyses; (6) Dental records and surveys; (7) Health/medical supplies delivery systems; (8) Hospital management information systems; (9) Population information; and (10) Education and training systems.

C. ENERGY AND NATURAL RESOURCES

(1) Energy survey data; (2) Process control equipment; (3) Communication system; (4) Natural resource inventory; and (5) Water resource development.

D. SMALL BUSINESSES

(1) Accounting; (2) Inventory control; and (3) Quality assurance systems.

E. EDUCATION

(1) Instruction systems; (2) Pupil records; and (3) Computational capacity.

F. INFRASTRUCTURES

(1) Municipal administration; (2) Municipal construction; (3) Transportation planning; (4) Zoning programs; (5) Census data; and (6) Tax records.

ANNEX B.—SECTOR SPECIFIC EXAMPLES OF A.I.D. PROJECTS WHICH USE MICROCOMPUTER TECHNOLOGY IN DEVELOPING COUNTRIES

AGRICULTURE

1. The Agricultural Planning and Administration Project contracted to Iowa State University utilizes microcomputers for project evaluation and word processing in Indonesia. (Cable Jakarta 17907—Nov. 1981)

2. The Remote Sensing for Agriculture Assessment Project (DSB/AG-1224-6-78) uses micro/mini-computers for compilation and analysis of survey data in developing countries including Ecauador (Cable Quito 0101—Jan. 1982), Sierra Leone (Freetown 3458—Oct. 1981; BUCEN survey), The Philippines (BUCEN survey), Jamaica (BUCEN survey), Morocco, Tunisia, Liberia, and Sudan.

3. The Agricultural Management and Planning Project (631-0008) in the Cameroon will use microcomputers for agricultural statistics. Software has been developed by USDA. (Cable Yaounde 8607—Nov. 1981)

4. An Agriculture Survey and Analysis project will use microcomputers in conjunction with the computer at the Bureau of Census, Government of Rwanda. (Cable Kigali 2829—Oct. 1981)

5. The Local Crop Survey Research Project will use microcomputers for agronomic research activities. (Cable Kagali 2829—Oct. 1981)

6. SAFGRAD Farming Systems unit project uses microcomputers to compile and analyze socio-economic and agronomic data. A set of software programs has been developed for purposes of this type of anlaysis for in-country use in LDCs. (Cable Ouagadougou 6247—Nov. 1981)

7. The Institute for Rural Economics in Mali uses a microcomputer for data management and analysis under the Regional Agricultural Research Project. (Cable Bamako 6947—Nov. 1981)

8. The West African Projects undertaken by Purdue University use microcomputers to encode and edit data in Francophone countries of West Africa including Mali, Upper Volta, and Niger (BUCEN Telcon with Ken Jones 12/24/81)

LABOR

1. The Non-Fram Employment Project conducted in Egypt by Michigan State University uses microcomputers in conjunction with mark sense readers for data entry, data processing, and data management and analysis. (BUCEN survey)

EDUCATION

1. The Satellite Communications Project (USAID/Suva 879-8254) through a grant to the University of the South Pacific involves linking campuses in the South Pacific region in order to support teaching and extension activities (especially in agriculture). The project uses microcomputers in eight different sites for message storage and retrieval. (Source: S&T/ED, Cliff Block)

2. A.I.D., through the Office of the Science Advisor, is exploring with the University of Nebraska the feasibility of using microcomputers in connection with videodiscs for science teaching in LDCs. The teaching of basic sciences is a major problem for developing institutions in LDCs because of inadequately trained faculty and the scarcity of laboratories and other science facilities and materials.

NUTRITION

1. A nutrition project (522-0124) in Honduras uses a microcomputer for analysis of the impact on nutrition of agriculture policies. (Cable Tegucigalpa 8430—Nov. 1981)

POPULATION

1. The Family Planning/Maternal Child Health project of the Ministry of Health in Nepal has developed a microcomputer based data management system. (Memo from G. Van der Vlugt, USAID/Kathmandu—July 1981)

2. The Integrated Population/Development Planning Project (S&T/POP/PDD 932-0655) developed a cost-benefit analysis, using a microcomputer, for the Ministry of Health in Thailand. The Family Health Division of the Ministry of Health continues to use the microcomputer for presentations of this analysis. (Source: S&T/ POP/ PDD, Sara Seims)

3. The Resources for the Awareness of Population Impact on Development (S&T/ POP/PDD 932-0637) project develops country specific analyses on the impact of population growth on development which are presented to LDC leaders. Microcomputers have been transferred to 15 developing countries in all regions, primarily to national statistical institutes, planning or health ministries, population commissions, or private family planning associations. (Source: S&T/POP/PDD, Judith Seltzer or Adrienne Allison)

RURAL DEVELOPMENT

1. The Confederation of Yemeni Development Associations with A.I.D. support (USAID/Sanaa 279-0045) is developing a rural development information program using microcomputers. Initially, the primary focus of the program will be data storage for retrieval. Basic socio-economic indicators and project data (purpose, financing source, status of implementation, including disbursement, etc.) will be stored by geographic area, and governing local development associations will have programs to retrieve data along various parameters. (Cable Sanaa 7467—Nov. 1981)

2. A small activity project (project no. 936-5316, grant no. A.I.D. DSAN C-0251) with Carl Gotsch Associates involves the application of microcomputers in the management of programs within the Ministry of Agriculture in Kenya. The pilot project is testing applications of microcomputers at all levels within the Ministry of Agriculture. The experiences thus far have focused on budget processing, financial planning, cost-benefit analysis as well as to processing of farming systems data.

3. Under the Alternative Rural Development Strategies Project (931-1190, A.I.D./ ta-CA-3) Michigan State University is studying the application of microcomputers and programmable calculators to rapid processing of farm/farm household data. A conference to inventory present applications in the developing world was held in May 1982. A state-of-the-art paper will be prepared and presented for discussion at a similar conference for practitioners from the developing world in late 1983.

4. Cornell University set up a Rural Development Information System in Kasserine, Tunisia, at the Central Tunisia Development Agency, which utilizes microcomputers. (BUCEN survey)

HOUSING

1. A project is being proposed to assist in the selection of microcomputers for the Ministry of Housing in Tunisia in conjunction with the development of information management systems. (Cable Lisbon 04063)

HEALTH

1. The Ministry of Health in Morocco uses microcomputers to facilitate data management. Specifically the Ministry of Health has been developing a file for tracking the epidemiology of 24 major diseases. Software for these data has been developed, under an A.I.D. contract, which enables analysis of diseases with extensive epidemiological, socio-economic and environmental factors. (Cable Rabat 8386—Nov. 1981)

ENERGY

1. The Ministry of Energy and Mines in Morocco, working with technical assistance from two U.S. firms under contract to A.I.D.'s Office of Energy (Project 936-5703), is using an analytical model programmed on a microcomputer to evaluate proposed energy supply projects. The model uses the Moroccan government's estimates of future energy demand and established policy constraints (e.g., the need to improve Morocco's balance-of-payments position) and calculates for each proposed project the expected rate of return, energy supply contribution, risk of failure to make that level of contribution, foreign exchange requirements, employment impacts and other variables.

2. During a second-phase project, Energy Policy Development and Conservation (936-5728), A.I.D. will assist the Moroccan Ministry of Energy and Mines in using its microcomputer for several other applications relating to Ministry functions. The Ministry has asked, in particular, for assistance in controlling its inventories and distribution of petroleum products and for analysis of the impacts of energy pricing on the output and the future energy demand of several energy-intensive industries.

STATISTICAL DATA PROCESSING

1. The Bureau of Census is currently funded by the Office of Science and Technology to study the feasibility of using microcomputers in national statistical offices of developing countries. The project will produce a data base of microcomputer users and vendors of software and hardware. It will culminate with an extensive document which addresses the introduction of microcomputer technology in the developing country setting. Activities to be funded under a future project include development of statistical software for microcomputers, expansion of the instruction offered by BUCEN's international training program in the field of microcomputers, and development of a periodic means of communication among microcomputer users in LDC's.

Mr. GORE. Thank you very much. We will hold up our questions until the panel has been completed.

Mr. Kalmann Schaefer is special assistant to the chairman for international affairs of the Federal Communications Commission.

Without objection, your full statement will be put in the record as well, and we invite you to proceed as you see fit. Welcome.

STATEMENT OF KALMANN SCHAEFER, SPECIAL ASSISTANT TO THE CHAIRMAN FOR INTERNATIONAL AFFAIRS, FEDERAL COMMUNICATIONS COMMISSION

Mr. SCHAEFER. Thank you, Mr. Chairman.

At the outset I would alert the subcommittees that I do not have my statement at the moment, but I will provide it in the next day or two, since I just arrived from a trip to Europe and wrote my comments on the plane, and I have not had a chance to reproduce the statement.

Mr. GORE. That is fine. I understand you just got back from Rome this morning. Is that correct?

Mr. SCHAEFER. Just about.

Mr. GORE. Under those circumstances, we will hold the record open for your statement.

Mr. SCHAEFER. Thank you, sir.

Listening to the discussion that took place earlier and particular comments that have been made by Dr. Kay, what I heard at least was that the issue is perhaps not so much one of transfer of technology but really access to technology and to information.

If we accept this premise, what we are in effect addressing is, in addition to the very substantive aspect of that problem—access—when we talk about access, we discuss international trade, both in terms of equipment and information transfer.

I will focus my remarks, Mr. Chairman, largely on the hardware part, which indeed provides the networks through which this information flows. The problems affecting the competitive environment for U.S. information technology exports may be summarized as follows:

The U.S share of world communications equipment markets has declined despite U.S. price-quality advantages.

Second, the promising opportunities for U.S industries to capture new export markets are in danger of being lost if such opportunities are not seized as they occur.

Barriers to U.S. information technology exports resulting from differences in equipment standards and specifications are likely to continue. Collaboration between foreign governments and their telecommunications equipment industries, for example, handicaps the efforts of U.S. equipment manufacturers competing for sales both within these countries and third country markets.

The ability of the U.S. manufacturer to compete effectively in overseas markets is influenced by a number of factors. The degree of manufacturers' commitments to export markets as a matter of basic business strategy and changes in currency valuations which broadly affect import-export relations are important aspects.

Other factors lie within the realm of consideration for U.S. Government policy or program action and concern price and financing, technical standards and specifications, other nontariff barriers, Government regulatory policies, and technological developments.

Where financing is a factor, foreign competitors have sometimes been able to arrange more attractive terms than those available to U.S. exporters. Industry representatives have cited maturities, local cost coverage, percentage of contract value financed, interest rates, and the absence of mixed credit facilities as areas where U.S. manufacturers are at a disadvantage vis-a-vis foreign-based suppliers.

It has been argued that competitors of the U.S. industry and other Western nations have access to government-sponsored programs which may give them price advantages in third-country markets. Among these programs are low-interest loans, R&D subsidies, and barter facilitation arrangements for sales to nations whose currencies are not fully convertible or with inadequate foreign currency resources.

In Europe and Japan, nontariff barriers are often used to protect domestic industry from competition with outside sources of supply. Government procurement policy and rules of origin are among the obstacles that restrict U.S. penetration of these markets. Some less

developed countries have also developed rules and policies which limit marketing opportunities for foreign-based manufacturers of information technology equipment.

Another nontariff barrier—another kind of nontariff barrier—to free trade in information technology equipment relates to the development and use of technical standards. While American exporters recognize the need to adapt their products to international standards, they are troubled by the existence of a large number of different national and regional specifications and procedures that can hinder U.S. access to foreign markets or increase U.S. production costs to the point of being noncompetitive.

U.S. Government regulatory policies can affect U.S. trade, in communications equipment in particular, in several ways. An FCC ruling can open U.S. markets to foreign competition without exacting quid-pro-quo reduction in barriers to U.S. penetration of domestic markets in other trading nations.

For example, a ruling by the Federal Communications Commission in 1968 known as the *Carterphone* decision, which held that companies should be able to interconnect their own terminals and PBX's to public switch networks, created a significant new competitive environment in the United States. Indeed, it was the beginning of the deregulatory process in the area of communications.

U.S. telephone and telegraph equipment manufacturing firms already operating at full capacity were given no head start or lead opportunity. On the other hand, this allowed foreign firms to move in virtually overnight and capture a major share of the interconnect market in the United States.

Such decisions in support of free trade, which has been the cornerstone of U.S. policy, are however in sharp contrast to regulations promulgated in other industrialized countries which often serve to protect their domestic industries by constructing various barriers to competitive sales by foreign firms.

In the area of antitrust, existing laws may bar U.S. telecommunications companies from forming concerted action to expand exports which are permitted by the governments of their foreign competitors.

The policies of foreign governments may also threaten the ability of the U.S. information technology industry to translate current technological leadership into sales in overseas markets, as competitor countries seek to improve their trade positions in high technology areas by subsidizing their R&D activities of their own manufacturing industries.

Even if U.S. industry does succeed in perfecting commercial applications of new technologies in advance of manufacturers in Europe or Japan for example, it will have to move quickly to sell the cost and technological advantage of these applications to foreign buyers.

Mr. Chairman, what I have attempted to outline thus far is a brief synopsis of some of the impediments and problems of expanding the U.S. share of an ever-increasing world market for information technology. I believe there are some measures which both the U.S. Government and industry can undertake which would address specific attributes of the information technology export environment and which deserve fairly prompt attention and yet do not

make disproportionate demands on the budgetary resources or foreign policy leverage of the U.S Government.

Clearly, some of these measures will require additional study; others could be implemented rather quickly. If I may, let me briefly outline some of these measures.

First, both industry and Government should seek to influence the development of performance criteria, equipment standards, and specifications by foreign nations and international organizations so that they do not work to the disadvantage of American manufacturers.

Second, form a U.S. Government-industry advisory group to oversee U.S. participation in the development of international standards, type acceptance, and certification arrangements.

Third, provide special training to U.S. foreign service commercial officers who are serving in U.S. embassies overseas regarding the structure of supply and demand for communications equipment in U.S. export markets.

Fourth, study the formation of an industry consortium or trading company dedicated to increasing exports from U.S.-based manufacturers of information technology equipment.

Fifth, develop a Government-industry mechanism to focus high priority attention on export opportunities involving commercial applications of new technology.

Sixth, develop through U.S. agencies special devices, such as barter arrangements, repayment in local currencies, or other techniques, for financing sales to Third World countries.

These, Mr. Chairman, are some of the measures that could have an immediate, and some of them perhaps a longer term, effect on the U.S. position in the international market.

Thank you very much. I will be happy to answer any questions you may have.

[The prepared statement of Mr. Schaefer follows:]

STATEMENT OF KALMANN SCHAEFER, ASSISTANT TO THE CHAIRMAN FOR INTERNATIONAL COMMUNICATIONS, FEDERAL COMMUNICATIONS COMMISSION

Thank you Mr. Chairman. I am pleased to be here this morning and my comments are primarily directed to the issue of U.S. information technology exports and its opportunities, difficulties and problems. I know that Chairman Fowler of the FCC is concerned and has directed the staff to pay particular attention to the potential effects of regulatory policies on international trade in the area of communications.

The problems affecting the competitive environment for U.S. information technology exports may be summarized as follows:

The U.S. share of world communications equipment markets has declined despite U.S. price quality advantages.

Promising opportunities for U.S. industry to capture new export markets are in danger of being lost if such opportunities are not seized as they occur.

Barriers to U.S. information technology exports resulting from differences in equipment standards and specifications are likely to continue.

Collaboration between foreign governments and their telecommunications equipment industries handicaps the efforts of U.S. equipment manufacturers competing for sales both within these countries and in third country markets.

The ability of U.S. manufacturers to compete effectively in overseas markets is influenced by a number of factors. The degree of manufacturers' commitment to export markets as a matter of basic business strategy and changes in currency valuations, which broadly affect import/export relationships are important aspects. Other factors lie within the realm of consideration for U.S. government policy or program action, and concern price and financing, technical standards and specifica-

tions, other non-tariff barriers, government regulatory policies, and technological developments.

Where financing is a factor, foreign competitors have sometimes been able to arrange more attractive terms than those available to U.S. exporters through the commercial banking system of EX-IM bank programs. Industry representatives have cited maturities, local cost coverage, percentage of contract value financed, interest rates, and the absence of mixed credit facilities as areas where U.S. manufacturers are at a disadvantage vis-a-vis foreign-based suppliers.

It has been argued that competitors of the U.S. industry and other western nations have access to government-sponsored programs which may give them price advantages in third country markets. Among these programs are low interest loans, R&D subsidies and barter facilitation arrangements for sales to nations whose currencies are not fully convertible, or with inadequate foreign currency resources.

In Europe and Japan, non-tariff barriers are often used to protect domestic industry from competition with outside sources of supply. Government procurement policy and rules of origin are among the obstacles that restrict U.S. penetration of these markets. Some less-developed countries have also developed rules and policies which limit marketing opportunities for foreign based manufacturers of telecommunications equipment.

Another kind of non-tariff barrier to free trade in information technology equipment relates to the development and use of technical standards. While American exporters recognize the need to adapt their products to international standards, they are troubled by the existence of a large number of different national and regional specifications and procedures that can hinder U.S. access to foreign markets or increase U.S. production costs to the point of being non-competitive.

U.S. government regulatory policies can affect U.S. trade, in telecommunications products in particular, in several ways. FCC rulings can open U.S. markets to foreign competition without exacting quid pro quo reduction in barriers to U.S. penetration of domestic markets in other trading nations. For example, a ruling by the Federal Communications Commission in 1968 (Carter phone decision) which held that companies should be able to interconnect their own terminals and PBX's to public switched networks created a significant new competitive market. U.S. telephone and telegraph equipment manufacturing firms already operating at full capacity were given no head start or lead opportunity, allowing on the other hand, foreign firms to move in virtually overnight and capture a major share of the interconnect market in the United States. Such decisions in support of free trade, which has been the cornerstone of U.S. policy, are however, in sharp contrast to regulations promulgated in other industrialized countries, which often serve to protect their domestic industries by constructing barriers to competitive sales by foreign firms. In the area of antitrust, existing laws may bar U.S. telecommunications companies from forming concerted action to expand exports which are permitted by the governments of their foreign competitors.

The policies of foreign governments may also threaten the ability of the U.S. information technology industry to translate current technological leadership into sales in overseas markets, as competitor countries seek to improve their trade positions in high technology areas by subsidizing the research and development activities of their own manufacturing industries. Even if U.S. industry does succeed in perfecting commercial applications of new technologies in advance of manufacturers in Europe and Japan, it will have to move quickly to sell the cost and technological advantage of these applications to foreign buyers.

Mr. Chairman, what I have attempted to outline thus far is a brief synopsis of some of the impediments and problems of expanding the U.S. share of the ever-increasing world market for information technology. I believe that there are some measures which both the U.S. government and industry can undertake which would address specific attributes of the information technology export environment and which deserve fairly prompt attention and yet do not make disproportionate demands on the budgetary resources or foreign policy leverage of the U.S. government. Clearly, some of these measures will require additional study, others could be implemented rather quickly. If I may, let me briefly outline some of these measures:

(1) Both industry and government should seek to influence the development of performance criteria, equipment standards and specifications by foreign nations and international organizations so that they do not work to the disadvantage of American manufacturers.

(2) Form a U.S. government/industry advisory group to oversee U.S. participation in the development of international standards, type acceptance and certification arrangements.

(3) Provide special training to U.S. foreign service commercial officers who are serving in U.S. Embassies overseas, regarding the structure of supply and demand for telecommunications equipment in U.S. export markets.

(4) Study the formation of an industry consortium or trading company dedicated to increasing exports from U.S.-based manufacturers of information technology equipment.

(5) Develop a government/industry mechanism to focus high priority attention on export opportunities involving commercial applications of new technology.

(6) Develop through U.S. agencies special devices such as barter arrangements, repayment in local currencies or other techniques for financing sales to third world countries.

These Mr. Chairman are some of the measures that could have an immediate and some of them, long term, effect on the export of U.S. informatioin technology equipment. Thank you very much and I'll be pleased to answer any questions that you or members of the subcommittees may have. Thank you.

Mr. GORE. Thank you very much for a fine statement.

Mr. Phillips, the IPDC was our proposal; is that correct?

Mr. PHILLIPS. That is right.

Mr. GORE. Why is it then that we shy away from it?

Mr. PHILLIPS. I am not sure I understand.

Mr. GORE. We shy away from making contributions directly to it; is that correct?

Mr. PHILLIPS. That is right. Our idea was to form such a group to consider communication needs. We did not have an opinion when it was formed on how it would actually work. In early discussions it was our strong view that the IPDC should be open to any kind of contributions that members would like to make. Some countries have indeed contributed directly to an IPDC central fund. We argued strongly that those who wished to do so should have that right, but those that wished to pick and choose—to tailor their aid to projects which seemed to them to be more in tune with what they would like to do or were capable of doing—should have that option too, and that approach was accepted at the last IPDC meeting, and that is how aid to IPOC projects is proceeding.

Mr. GORE. Our contribution is approximately equivalent to that of Indonesia; is that correct?

Mr. PHILLIPS. I think Indonesia's is slightly higher than ours. Our official Government contribution is $100,000 for the first year.

Mr. GORE. Mr. Farrar, will the $100,000 earmarked from AID's budget be a one-time contribution, or is that in the nature of an ongoing commitment?

Mr. FARRAR. I do not believe that there has been any commitment beyond the $100,000. I think the question of future commitments is an open one at present.

Mr. GORE. OK. I will get to my other questions in a moment. I would like to recognize Mr. Walker.

Mr. WALKER. Thank you, Mr. Chairman.

Is there any kind of danger in the opinions of your agencies of an introduction of microcomputer equipment into lesser developed nations, the problem arising from the fact that they would tend to move toward that technology before they had developed other basic infrastructure and thereby make a leap ahead that over a long term might be a severe problem? Is there a danger in any U.S. policy that pushes that into Third World nations?

Mr. FARRAR. There are certainly dangers involved in rapid technological change for any society. What you frequently see in devel-

oping countries is the investment of large resources in technologies that are too expensive for them to be able to maintain or really afford or that require some kind of human infrastructure or institutional infrastructure that is lacking in order to operate.

I think one of the advantages of the microcomputer is that the dangers of that kind are considerably less.

On the more philosophical level, I think our experience has been that developing countries are able to use very advanced technologies and, in effect, skip over the years of learning process. You find that some of the least developed countries in Africa are perfectly able to use remote sensing data in a sensible way, and it would not make sense to suggest that they ought to use a less efficient technology.

So our experience is that the sort of basic philosophical problem you were raising does not appear to occur on the practical level.

Mr. WALKER. To some extent I am raising an economic problem too. I realize that it is in large part a philosphical problem, but I am also raising an economic problem in this sense: It seems to me that it is of tremendous advantage to the United States, obviously, to export computer technology. Microcomputer technology becomes a major market for us, but I am wondering whether or not we create some long-term problems for this country in our own national interest down the line if we push this computer technology into these countries, and I wonder if we have evaluated what those long-term problems might be in creating computer-conscious societies where there is no basic infrastructure to handle that kind of processing ability. I guess I am asking, have we looked at it?

Mr. SCHAEFER. Let me just comment on that. I do not really have the answer to your question, but perhaps an analogy can be drawn to support Mr. Farrar's point in the general area of communications.

If you recall the advent of satellite communications is fairly recent; I suppose the mid-1960's or late 1960's was when it really took off. I am talking about commercial-type satellite communications.

As you may know, today most of the Third World countries are participating in some fashion or another in the global satellite communications system. All it has taken is some resources—at that time some $6–$7 million—to build a satellite earth station and suddenly communicate and have a window to the world, so to speak. That was high technology they were able to assimilate.

There you also had the problem of inadequate infrastructure, so the situation we have at the moment in many Third World countries is that the communications system is well developed probably in the capital, and they have access to the satellite Earth station, and the rest of the country has very little access or poor access. Yet they are able to assimilate that high technology and operate very well.

From the point of view of the United States' national interest, introduction of this new technology was a good move, since we have much better communications with these countries at least in a commercial sense and even in an official capacity. Not only did it offer markets to U.S. manufacturers but offered better communications between us and some of these countries.

Mr. WALKER. To take your analogy one step further, I understand that, and I do think that those advantages are quite clear. However, do we not also, in exporting to them that kind of communications ability, export with it—let us say a land where they have severe hunger problems. Are we not also in the process of communicating to them that there are places in the world with huge surpluses of food? What kind of political ramifications does that bring to a population that all of a sudden becomes familiar with the fact that there may be means to solve their problems that they are not participating in? What kind of undermining of their government does that bring about, and does that then over the long haul cause problems for U.S. interests?

Mr. FARRAR. I think to a very considerable extent the answer is that there is relatively little we can do either to make more serious or to prevent the problems you are referring to. There is nothing to prevent an exchange student in the United States from a developing country from picking up a small computer, carrying it home with him and beginning to use it. The communications revolution is there. It is not something that we can either stop or particularly speed up. Further, microcomputers generally represent a more affordable means of processing small amounts of information than the mainframe computers on which LDC's have relied in the past

I think what we can do is try to relate the capacity of these technologies, including the microcomputer, to solving the problem of hunger more effectively and try to meet the issue that way.

Mr. WALKER. As I said, I guess my basic question was whether or not we were in process of assessing some of those kinds of things, because I think we are in a position of introducing a great deal of technology into the world, and obviously it is in our economic interests to pursue that, but I think we have to, as a matter of Government policy, not necessarily as a matter of commercial policy, look at national interest questions as to whether or not we can create situations in those nations that make government viability untenable at some point or make populations in those countries—maybe even divide populations between the technological competents and technological incompetents and thereby create almost a class system within countries as a result of access to the technology that we are exporting. I just think that you can raise all kinds of social and economic problems, without really meaning to do so, if you do not assess what it is you are doing in the first place.

Mr. FARRAR. As far as AID is concerned, we do make a deliberate effort in each of our activities to look at what we call social soundness, which includes this range of questions.

I would have to add that anybody's ability to foresee the full implications of what one does is extremely limited, so that you have to be modest in your expectations of how well you can do, but those certainly are issues which we try to address.

Mr. WALKER. Thank you.

Mr. GORE. Mr. Schaefer, the FCC currently has a notice of inquiry out concerning technical assistance to LDC's; is that correct?

Mr. SCHAEFER. Yes, sir.

Mr. GORE. What is the status of that notice of inquiry?

Mr. SCHAEFER. The notice has been out for some time, and we have been receiving a number of responses from industry. Let me

just briefly indicate what the purpose of the notice was and what it covers.

The International Telecommunications Union, which is a specialized agency of the United Nations, is providing technical assistance in the area of communications, in particular, training for third world fellows who obtain fellowships through the UNDP, and then the ITU sends them to various parts of the world to obtain the training.

The FCC, for the past 40 years, has been essentially a liaison with the ITU, placing these foreign trainees or fellows in industry in the United States. Industry gets paid for it through the UNDP fund, and the fellows obtain the training.

There is a clear advantage to this kind of program which is probably the best buy the U.S. Government has these days, because it does not cost us much, except for two people who are working in the agency and placing these people, because these trainees, once they return to their countries, are familiar with the technology, and it opens possibly the doors for U.S. equipment sales in that market in addition to helping the country help itself.

The purpose of the notice of inquiry was to gather a larger population of possible U.S. training facilities as well as U.S. industrial entities prepared to participate in this training program. The response has been encouraging thus far.

Mr. GORE. There have been increasing pressures from the LDC's at meetings of the ITU for technical assistance; is that correct?

Mr. SCHAEFER. Yes, sir, there have been for some years. We are about to have an ITU Plenipotentiary Conference in Nairobi, Kenya, in the fall of this year, where again this theme of increased technical assistance is certain to come up.

Mr. GORE. Mr. Farrar, where do information communications computer projects stand in your list of priorities for development funding?

Mr. FARRAR We have relatively few projects that could be so characterized. We have a great many projects that have an information computer aspect to them, and their priority would depend on the country location and the substance of the project.

One of the things that we are now beginning to look at is whether we need to devote more explicit attention particularly to the microprocessor, but we do not have, so far as I know, a single project that is exclusively on that subject except for one or two research grants which are looking at aspects of the use of microcomputers in development.

Mr. GORE. So it is fair to say that probably because the technology is relatively new and its potential has not been fully assessed yet, it has not been on your list of priorities; it has not been defined as a basic need certainly, but you are reevaluating whether or not it should be assigned a higher priority; is that fair to say?

Mr. FARRAR. We are receiving the way in which we should deal with microcomputers as an increasingly important element in much of what we do. On the other hand, our priority judgments tend to be about end results rather than means. That is, we are concerned with food production or the effectiveness of an education program. I think we would regard the microcomputer as a means

to these ends and not as a major project focus in the same sense that improved nutrition would be.

That does not mean that we are not going to devote a lot of attention to the appropriate role of microcomputers in development and what more we should be doing about that role; we are.

Mr. GORE. The World Center witnesses last month used nutrition and agriculture as prime examples of how personal computers could be of tremendous assistance to these countries. Aside from bilateral assistance programs supported by AID, are you involved with any multilateral efforts to build information infrastructures to deal with this technology?

Mr. FARRAR. The UNDP was just mentioned of course. The U.S. Government does support the UNDP and is in that sense supporting that activity. We are exploring support to the U.N.'s National Household Survey Capability Program, for example.

We have been in touch with other agencies with an interest in this area. The World Bank, for example, I think is in very much the same stage that we are in considering the role for microelectronics technologies and what they Bank ought to be doing. We have begun discussions on the topic with them. An organization that has been especially forward in the information field is the International Development Research Center of Canada, which has developed information systems of particular relevance to developing countries. We have recently adopted their software as the basis of our own agency's science and technology information system.

The answer to your question is that we are in touch with other organizations, and of course we finance the multilateral institutions. I am not aware of any major programs in this field that we are supporting as such.

Mr. GORE. Mr. Phillips, could you describe for us the status of the effort to establish a private sector committee to address this problem?

Mr. PHILLIPS. Yes, I can. A member of our delegation to the IPDC Acapulco meeting was a private sector adviser. He is a communications expert and consultant from the State of Ohio named Tahlman Krumm. He came back from Acapulco convinced that there is a major role to be played in the communications development sector by our private sector. He has taken on the role of sounding out various industries and communications-related companies on their willingness to participate in some sort of loosely formed industry committee that would look at IPDC projects and see how they could plug into them. He is just about to give us a progress report on where he stands; I have not seen his report, but informally in talking to Mr. Krumm, I have the impression that he has made good progress; he has found quite a bit of interest in the private sector in doing something in this area.

Mr. GORE. Is it your impression that we need new mechanisms to establish a strong working relationship between the various government efforts and the private sector with respect to this matter, or do you think the current dialog and framework is adequate to the task?

Mr. PHILLIPS. In answering, let me go back to one of your earlier questions you addressed to Mr. Farrar. One of the problems that we have found in both our own Government or in governments we

deal with is that communications as an area of development does not get very high priority. It is not a basic human need that we look at as such.

When I traveled around—I made an extensive trip in Latin America before the IPDC meeting—I found that if I would go to people in the various governments responsible for development, they would not have any idea what I was talking about when I mentioned communications development; they were thinking about other things. So you would have to find somebody, usually in the President's office, who was in charge of press relations or something before you would get somebody who would understand what you were talking about, what UNESCO was, what the IPDC was, and so on.

So I feel that if there is a communications revolution upon us, as we have heard from others testifying before this committee, if it is tremendously important not only to this country but to the world, then I think we should be focusing more on how such developments can be used in our relations with the other countries.

I think there is an immense role for private industry in this field, because they have technological leadership, they have contacts abroad, and they have know-how.

What I would prefer to see is, if initiatives in this area are to bear fruit, is to have Government work with private industry but let the private sector have a rather independent role; let the Government provide the framework, such as the IPDC, let government-to-government negotiations establish a clearinghouse process, provide some Government money as possible, but let the main thrust come from private industry in picking up on those projects that are worthwhile.

Mr. GORE. In discussing what role Government should play in that, a lot of times the debate gets bogged down on whether it should be a big role or small role or whether it should be centralized or diffused. It just seems to me that that whole argument misses the point. It occurs to me that, if we are really going to establish this kind of working relationship, have some sort of goal alignment that sensibly addresses the potential that is out there, it has to be a different kind of role played by Government.

You referred to the image of a clearinghouse. That gets at the different kind of role Government ought to be playing in areas like this, but I am not sure we have done a very good job of creating mechanisms of that kind. Would you agree?

Mr. PHILLIPS. Let me comment that one problem is that most of the countries in the Third World prefer to deal government-to-government, particularly when they are talking about something as sensitive to them as the transfer of communications technology; I mean when you are talking about how they are going to organize their press and their media, and they are very reluctant to be in a position of taking assistance from IBM or from IT&T or from the World Press Freedom Committee, or whatever, because that has a connotation in their society which they wish to avoid.

The analogy that I make is this; I suppose that "the Washington Star" could have been saved had the Libyans wished to invest in it and put up the money to save it.

Mr. GORE. Or Reverend Moon.

Mr. PHILLIPS. Or Reverend Moon. I do not think the Star would have had much credibility as an independent newspaper had they accepted funds from Libya. Well, the Third World countries have a similar "image" problem. They need and want a government-to-government relationship.

But I do not think that in this sector, at least the less technologically advanced sector that I am talking about, which is really how to improve their media capability—training of journalists, getting some presses in some cases—very primitive stuff compared to what my colleagues have spoken about—I do not think that the Government is necessarily the best institution to provide the aid. I think it is Government's role to identify the needs and then try to get those that are capable of providing it to work through us and with us to give it to them.

Without knowing anything about it whatsoever, Mr. Chairman, I am very impressed with the notion that I have heard of the French initiative, something that has some government and I guess private sector appeal and usefulness. Maybe something like that would be helpful.

Mr. GORE. Several of our witnesses have come to the same tentative conclusion.

I want to thank all three of you for helping us in this endeavor. We appreciate your testimony and your contribution here this morning. Thank you very much.

Our final panel consists of Dr. James Oliphant with the Intel Corp., and Dr. Michael Golhaber with the Institute for Policy Studies.

Gentlemen, would you come forward to the witness table?

Welcome. We thank you for your patience in waiting until the end of the hearing. Without objection, your prepared statements will go in the record, as is our custom. We invite you to summarize, or if you prefer to present your entire statement, that is OK too.

Mr. GORE. We will begin with you, Dr. Oliphant. Welcome. Please proceed.

STATEMENT OF JAMES OLIPHANT, INTEL CORP.

Mr. OLIPHANT. Thank you, Mr. Chairman.

First of all I would like to express my gratitude and express my pleasure for the opportunity to address you and your subcommittees this morning.

I would like to direct my remarks this afternoon to observations and recommendations that I made in my role as a technical consultant for the United Nations Industrial Development Organization which sponsored a mission on selective microelectronic applications in developing countries. We toured in May-June of this year the countries of Egypt, India, Thailand, and Mexico.

The objectives of this mission were to aid in the increasing awareness of the decisionmakers in the developing countries of the role of microprocessors in providing solutions to identify problems.

Second, it was to identify the capabilities of selected examples of the existing technical and business infrastructures in these developing countries which are charged with bringing microprocessor-based applications to their marketplace.

Third, we were charged with the task of recommending specific applications as examples which were suitable for microprocessor implementation in those developing countries.

As part of these objectives, we evaluated applications across the applications spectrum—the so-called applications spectrum—ranging from high end to low end. I would characterize this applications spectrum on the high end as being involved in much of what we have heard here this morning and this afternoon as dealing with what we classically call computers. I would classify the low end as a rather interesting application area that we refer to more as microcontrollers. I will expand on that a little bit more in the presentation.

Specifically, we aimed our study of these application potentials in such critical need areas as agriculture, energy, health, transportation, and, most importantly, process control in existing industries in those countries.

What we were looking at was to make the most use of the very scarce resources available to the developing countries—specifically, the resources of skilled manpower and capital.

The study that we undertook was by no means an exhaustive analysis in the countries, but it did provide a snapshot of what exists in the country, particularly with regard to their intent.

Some of the results that we found over the period of approximately 6 weeks were items not necessarily astounding, but taken together they form an interesting pattern. There are five areas.

No. 1, the first area was the critical shortage of skilled manpower specifically. There is a great need for training resources and for the retaining of those trained resources. We heard a great deal in the developing countries, particularly in Egypt, India, and Mexico, about the so-called brain drain or the retaining of their skilled manpower.

No. 2, we saw that the access to adequate and appropriate development tools required to develop microprocessor application was significantly below that required to sustain those applications.

By development tools, I am referring to both systems and software—systems such as personal computers, dedicated development systems, the software tools and utilities that go into these systems to make the application development a more viable process.

No. 3, on the list of the five results was the need to have a ready access to microelectronic components boards and subsystems. This has significant potential to whether or not the developing countries, when they do develop applications, are able to maintain adequate service, put into place adequate maintenance infrastructures to continue the development of their program.

No. 4, and this addresses something, Mr. Chairman, that I believe you raised earlier this morning—that is, we found the lack of an effective marketing distribution, sales, and maintenance infra-

structure in all of the four developing countries that we looked at. The lack of that effective marketing and distribution infrastructure is, in my opinion, going to seriously hamper the development of microprocessor and microcomputer applications in those countries, and it is something that needs to be addressed in the developing countries in a most expeditious manner, and it is something they are looking at—the recommendations we had.

No. 5, was the coordination of their VLSI technology strategies with the applications strategies. I would digress for just a moment here.

All of the developing countries we visited showed a very strong desire to have their own VLSI capability. I believe it was Mr. Walker who asked the question earlier this afternoon on what is the danger that we have in pushing these developing countries too fast into applications. I would submit that that is one area where we could virtually capsize the developing countries if the developing countries take the tack of committing their already scarce resources and manpower and capital to achieving VLSI parity with developed countries. I think that would be a serious miscalculation on their part.

Mr. GORE. Are you talking about VLSI manufacturing parity?

Mr. OLIPHANT. Yes, sir.

There are three basic messages that I would like to make in this presentation. Mr. Chairman, again you raised the first one at the outset in our remarks. I want to emphasize the strategic importance that was expressed to those of us on the mission that developing countries place on becoming self-reliant in the use of microelectronics. That was the No. 1 priority.

No. 2, again addressing something that you raised earlier—there is, in my opinion, an enormous potential market in developing countries for the application of microprocessor controllers at the low end to microprocessor based equipment, such as telecommunications equipment, at the high end. The limits of that kind of market are limited only by the imagination of entrepreneurs and designers in those countries.

No. Third, I would suggest a model to help unravel the complexities of the issues involved and to help focus attention on some of the possible solutions that we have been talking about this morning.

To be brief toward that end, I would suggest, much like Mr. Boring did this morning, that microprocessor technology transfer needs definition. One possible definition can be characterized by dividing it into four categories. The first is research and development, both research and development in chip design—process technology, architectural development. The second would be the semiconductor manufacturing—what I was referring to as VLSI technology. The third portion of microprocessor technology model is the application development tools that are required to implement the various applications that developing countries can begin to work on. Fourth is the system design capability of actually designing the applications into a systems environment.

I would suggest of that model in microprocessor technology the first two are things that require substantial manpower, R&D, and capital investments, and as such, in my opinion, it is not in the in-

terests of developing countries at this stage—and I emphasize "at this stage"—to focus on.

In this area I think the policies of the United States, if directed toward, let us say, effective policies showing a growth plan, if you will, concentrating on numbers three and four—that is, the providing of application development tools and providing consulting resources for system design—would be most appropriate.

There are of course many other areas that can be addressed, one of which I would like to address. That is the possible role that the United States might follow in helping developing countries achieve their stated objective of becoming self-reliant in the use of microprocessors, and that is for the Government here to support programs and fora, seminars, and such, which will heighten the awareness in the private sector of opportunities in developing countries.

I feel that the public role in the United States should be limited to this awareness of opportunities, as opposed to trying to create the opportunities. Similarly, roles of such agencies as UNIDO and the UNDP can act in a very critical role of focusing questions and problems that developing countries face in their quest to become self-sufficient.

In the area of problems, several developing countries do have restrictive import policies regarding the importation of computers of any sort, whether those computers are personal computers, computers used for development tools, software, development systems, and restrictive policies on microelectronic components and subsystems. When I refer to restrictive policies, I am referring to such things as high import duties associated with these components and systems. I believe those policies to be in detriment to their stated objectives, and this needs to be pointed out, both in international bodies and in governmental bodies.

The second problem area—and I will close with this—is what I perceive to be a lack of awareness and sensitivity on the part of private enterprise here in the United States regarding the significant potential for mutual benefit between these companies and developing countries in the potential that developing countries offer to new markets and innovative solutions to problems that we face. It is this second area of the problem area that I believe these subcommittees and indeed the U.S. Government can address to help increase the awareness and help developing countries achieve their stated objectives.

Thank you, Mr. Chairman.

[An overview from Mr. Oliphant follows:]

OVERVIEW

Rarely has a technology generated such intense interest for its potential to solve many problems as has that of "Microprocessor Technology". This interest covers such diverse fields as technical, economic,social and political. Even the term "microprocessor technology" has come to mean many different things to different people in the same discipline to say nothing of its intrepretation in the other non-related disciplines. For the purpose of this discussion, the term "microprocessor technology" encompasses the entire range of development, specifically:

1. Component chip design
2. Semiconductor manufacturing
3. Application development (both hardware and software)
4. System design and integration

Conditions surrounding the export of microprocessor technology depends heavily on which category is being considered. The first two of the four categories (that of component chip design and manufacturing at the VLSI level) are the most sensitive to proprietary information in private enterprises in developed countries. The export of "micro-processing technology" at these levels to developing countries (or elsewhere) has significant economic and political ramifications in both the private and governmental sectors particularly in the United States.

In determining the most effective policies in the exporting of micro-processor technology, it is useful to examine two major issues:

1. At what level <u>should</u> the United States support the exportation of the technology.

and

2. At what level are developing countries most capable of receiving the technology.

The most desirable situation results when the United States exportation policies closely match what is most needed in the developing countries.

The most often stated National Objective in the developing countries visited (Egypt, India, Thailand and Mexico) is the necessity of becoming self-reliant in the field of microelectronics. This self-reliance covers the range from agriculture and energy to information processing and computers in the application of microprocessor technology. This objective of self reliance, however, does not mean that developing countries want to "go-it alone" once having the technology. Rather it means having the ability to implement broad internal strategic

objectives without depending on developed countries or transnational corporations for obtaining their required applications. It is my opinion that developing countries want to control internally (in both the private and public sectors) the majority of the "added value" of a microelectronic system or application- a condition that most companies in the United States feel is important. It is well recognized in developing countries of the need to obtain some critical portion of the system from foreign sources - in both the short and long term. The more generally available these critical portions are (microprocessor components, memories,etc.) from developed countries or foreign companies, the more at ease developing countries are in depending on these sources.

It is my opinion that the most logical and desirable levels for developing general policies on the export of microprocessor technology by the United States are three and four above. These general policies directed at application development tools and system design and integration have the broadest interest and commonality of purpose. These are the levels that generate maximum added value for both companies in the United States and developing countries- a clear benefit to all parties. With new export markets opened in the United States in the areas of development tools and software and new applications markets opening in developing countries (for both their internal and export markets), the potential for mutual economic benefit is greatly enhanced.

The application development sector will open new and large markets for the export by the United States of personal computers, general and specific microprocessor development systems, mini/mainframe computers and software which are targeted for microprocessor application development. In many cases (for U.S. companies presently manufacturing such systems) little or no change in the targeted markets is required. In the System design and integration level, new opportunities exist for components, boards, OEM systems and the like exist.The key requirement is that the "added value" of the final application must be predominately contributed by the developing country. (Or at the very least, the potential for predominate added value.) In either case, new markets are opened for all concerned.

The observations I made and recommendations I have are the result of my participation in a mission sponsored by the United Nation Industrial Development Organization (UNIDO). The objectives and a summary of the findings and recommendations are contained in Attachment I.In addition, two reports (one each from India and Thailand) are included to provide background of the thought process and general direction being considered in certain segments within these two developing countries.To a large extent, these reports (Attachments II. and III.) reflect the general attitudes and thoughts that I observed during the mission in other developing countries.

Significant practical problems still need to be resolved before any of the potentials can be realized. Issues such as what technology levels can be exchanged by companies in the United States based on our own national interests must be resolved. Developing countries must resolve and re-evaluate restrictive import policies which effect the importation of development tools as well as microprocessor based components, boards and OEM systems if mutual benefit is to be realized. The issues are complex and thorny, but their timely and effective resolution will result in significant benefits to all concerned.

THE UNIDO MISSION on SELECTIVE MICROELECTRONICS APPLICATIONS in DEVELOPING COUNTRIES

James M. Oliphant
UNIDO Consultant

INTRODUCTION

The role of microelectronics in the economic fabric of developed countries continues its meteoric climb. The contributions and importance of this technology and its progeny, microprocessors , to the continued economic strength of a nation cannot be overstated.The uses to which these relatively new tools can be put are limited only by the imagination of designers and entreprenuers in their quest to provide either better or newer solutions to problems in industry, information processing, government ,and countless other fields. With this technology, new applications can be directed at giving renewed vitality to existing long standing industries such as textiles,manufacturing facilities, and others and to economic sectors such as agriculture, energy, and to increase productivity,capability , and quality. In addition, new innovative applications can spawn healthy products for both industry and service sectors.Many of these innovative applications take advantage of the incredible computing power that can now be placed in a package smaller than the palm of a hand. This computing power can be used for both simple and complex control and monitoring applications that would have been impossible just a few years ago.
With all of the attention being paid to this relatively new technology in developed countries and the resultant dramatic successes in an ever increasing range of applications, it is little wonder that developing countries want to exploit the full potential of this technology to reap the full benefits. The question is no longer "should" we (developing countries) become involved in developing microelectronic applications but is rather "how" can we best utilize our available resources (such as manpower,capital equipment, and money) to most effectively enter the field of microelectronics applications and gain control of the direction the technology takes in each country. The importance attached by each country to being a master of the technology and not subservient to its whims (often directed by outsiders whose interests and strategies may not match those of the developing countries) will determine whether or not adequate and timely support of this new field will be given.Both the public and private sectors play a vital role in achieving their common objectives in this area.

1. 0 MISSION OBJECTIVES

The UNIDO mission on Selective Microelectronics Applications in Developing Countries was formed to discuss and identify technical problem areas which are viable for microprocessor applications solutions. In addition, the Mission is to report on and recommend possible solutions to problems encountered which might inhibit or stop the development of such applications. To this goal, the mission has three primary objectives:

1.) to aid in the increasing of awareness of decision makers in tne developing countries of the role of microprocessors in providing solutions to identified problems
2.) To identify the capabilities of selected examples of the existing technical and business infrastructures in the developing countries which are charged with bringing microprocessor based applications to the marketplace and to make recommendations to increase their effectiveness.
3.) To recommend specific applications as examples which are suitable for microprocessor implementation.

The study thus undertaken was by no means an exhaustive analysis of all (or even most) of the capabilities of the countries visited (Egypt, India, Thailand, and Mexico) in the microelectronics applications field. The study is rather a snap-shot of selected technical and economic sectors, both public and private, at a particular point in time in both the individual countries and regions and an analysis of each of these snap-shots. The results, analysis,and recommendations of this study are intended to form a basis for both further discussion and, more importantly, action on the part of both public and private sector interests in the developing countries. It should be noted that one or more of the recommendations made in this report may already be implemented in some of these developing countries. These recommendations are included for completeness. The value of the analysis and recommendations lies in their synergy with one another and not necessarily on the individual recommendations.

2.0 SUMMARY

The ability of developing countries to effectively exploit and become competitive in developing microelectronics applications depends on four general factors. These four factors are:

1. availability of skilled technical manpower
2. Access to adequate and appropriate development tools.
3. Ready access to required microelectronics components, boards, and/or systems.
4. Effective marketing and distribution network.
5. Coordinating VLSI technology and application strategies.

It would be difficult, if not impossible, to objectively quantify each of these factors. However, it is entirely appropriate to use these factors to determine areas of strengths and weaknesses in the developing countries. In so doing, it is possible for each country to build on its strengths and develop programs and or policies to turn existing weaknesses into needed

strengths.
Each of these four factors is developed in more detail in Section 3 of this report. The recommendations outlined below come from the many discussions held with technical managers in both public and private sectors in the developing countries. Most of the recommendations are of a general nature and are intended to form the basis for introducing key issues into appropriate governmental and industrial policy making groups. Each developing country will certainly formulate its own policy based on the unique requirements and strategy in that country.

2.1 AVAILABILITY OF SKILLED TECHNICAL MANPOWER

It is well recognized that no nation, either developed or developing,has all the skilled technical manpower that it could use' There is a worldwide shortage of technical expertise (especially in the area of software).The worldwide competition for these resources is a factor which exerbates the other problems facing developing countries.
One problem in developing countries is the training and retaining the required technical manpower.Here developing countries are at a disadvantage relative to developed countries in two important aspects:

1. Training resources (both teachers and equipment) are in very short supply.
2. Internal perception among some technical people that the "really challenging jobs" are outside the developing countries.

The first aspect, that of scarce training resources, limits the number of skilled people that can be trained.The second aspect contributes to the losing of a significant percentage of those few who are trained after a relatively short time in productive work in the developing country. Clearly it is necessary to find solutions to both problems simultaneously if we are to avoid the problem of stagnation in the development of microelectronic applications due to lack of manpower. The total solution to this complex problem is clearly beyond the scope of this report. However, several constructive suggestions were made in each of the countries visited on how to provide a short term solution to minimize the impact of the problem.

2.1.1 RECOMMENDATIONS

1.) There is a strong consensus among technical managers in both public and private sectors in the developing countries visited that the training of technical manpower must be tied to the development of practical applications. For example, training courses in University classes at the graduate level and extension courses, should be tied TO SOME DEGREE to providing solutions to selected problems in an existing microelectronic application design project. The objective is to use the manpower and equipment in a training enviornment in the dual role of training and application development, thereby maximizing effectivness of both resources. Achiving this objective implies a very strong infrastructure in which to operate and communicate. While the pieces of the requiried infracture (such as Universities, Research Centers, Business groups) exist in all the visited countries, their interactin and communication are not presently structured to achieve the desiried objective. Section 3.0 provides more detail into this program suggested by many of the technical managers interviewed.
While this structure of using training resources for the dual role of training and application development is primarily a short term solution to a problem, it should form the foundation of a longer range solution. The use of classrooms to solve existing practical problems has many benefits for the trainer, trainee, and their corresponding institutions.
2.) The second recommendation strongly proposed in many of the meetings is to strengthen and expand the concept of the Cooperative Education Program (CO-OP) in the universities. In this type of program, the student is given the opportunity to pursue his studies and be assigned work projects in alternate acedemic terms(in other words study a semester, work a semester, etc.) The advantage of such a program is that it gives the student the chance to apply his thoretical knowledge to practical problems while providing a skilled resource to the country.
It is important to keep in mind that both recommendations (1 and2) require a strong infrastructure with the ability to communicate among the different organizations to assure success in tne achievements of the project.
3.) The third recommendation is to heigthen the awareness of the decision makers of the critical need to retain the trained engineer in the developing country.Retaining of engineers within the developing country should be afforded very high priority in appropriate governmental policy making bodies. It is beyond the scope of this report to suggest more concrete proposals, however, it is essential that factors such as pay, availability of challenging work, work environment, professional advancement opportunities be addressed at the appropriate level to provide strong positive incentives to remain as a national resource. To this end, technology exchange agreements with foreign companies could be structured with the aim of providing conditions that maximize the probability of retaining the indeginous technical resources.

2.2 ACCESS TO ADEQUATE AND APPROPRIATE DEVELOPMENT TOOLS

The tools required to effectively and efficiently develop microelectronic applications projects depend in large part on the type of application being developed. It is important to not only have an adequate supply of development tools but also to have the appropriate development tools. For example, attempting to use machine language or assembly language tools to

99-819 O--82---10

develop long and complicated software control programs not only wastes time ,money and manpower resources but also significantly increases frustration in the design engineers. Likewise, using large scale mainframe computers to construct relatively simple applications programs can create training problems in attempting to learn to communicate with the large scale mainframe computer. In addition, placing too much emphasis on tools for software development of application programs and not enough emphasis on software/hardware integration tools can seriously impact development schedules (not to mention development success). Because the issue of appropriate development tools is critical to the success of microelectronic applications development, Section xxx is devoted to a discussion of the topic. In summary, the following recommendations are made:

2.2.1 RECOMMENDATIONS:

1.)Microelectronic Applications centers are recommended to be established in selected locations. These centers can be used to provide both application development and training as outlined in this section. Details of center descriptions and functions is found in Section 3.0 . As discussed, these centers can be equipped for a relatively modest capital investment and, if appropriately structured, can be used as revenue generating centers on either a non-profit or profit basis.
2.)Because of the critical contribution of development tools (bith systems and software) to microelectronics application development, it is recommended that the appropriate governmental agencies/departments review existing and proposed policies (such as import restrictions, duties,taxes,etc.) to assure minimum impediments to obtaining such equipment especially for the proposed development centers.

2.3 READY ACCESS TO REQUIRED MICROELECTRONICS COMPONENTS

Having a ready access to microelectronics components is important not only to the application development effort but also to the Service and Maintence requirements of the application. In many developing countries,as a result of governmental policies, the importation of microelectronic components and boards can be a time consuming process. The result can be significant delays to applications programs and/or Service and Maintence requirements due to non-availability of required components or boards. It is recognized that the issues involved in these policies are complex and varied. However, it is recommended that the appropriate government agencies review the import policies regarding these components and boards to assure that the maximum national benefit is achieved for developing applications which have a high added value (see Section 3.0)

2.4 EFFECTIVE MARKETING and DISTRIBUTION NETWORK

An essential point of any microelectronic development program is getting the product into the marketplace. In developed countries there generally already exists a strong Marketing infrastructure residing in the various corporations and a strong Distribution infrastructure. (The term Marketing used in this report includes functions such as product definition, strategic analysis of application requirements, pricing strategies, service requirements, and direct sales strategies.) It was found that in developing countries the Marketing and Distribution networks were not as strong or well

organized as other aspects of the development program. It is this area that requires significant attention by both the public and private sectors if the applications, as they are developed, are to be fully exploited in both the internal and export markets.
A fundamental characteristic of the microelectronic market is the rapid introduction of new products and services and the rapid change in market conditions. To br able to compete in both internal and world markets, it is essential that marketing and Distribution networks be able to act and react rapidly to these changing conditions in the market place.

2.4.1 RECOMMENDATIONS

1.) The cornerstone of establishing an effective Marketing and Distrubution network is to provide strong positive incentives to corporations and individuals to get their products into the market. It is recommended that policies be pursued which strongly encourage the formation of distribution networks (for both sales and service) in the internal and export market. With the appropiate government policies in place, the networks should evolve into strong nimble organizations that are able to react quickly to meet the market requirements.
2.)The second recommendation is that a central organization be established that will act as a catalyst group for the development of microelectronic application. This group (described in more detail in Section 3.0) would be chartered to bring together participants in both the public and private sectors to identify application opportunities and to act in an advisory capacity on marketing and distribution issues to both governmental and industrial groups. It is this organization to which industrial, govermental, and educational groups could turn for advice regarding the many issues that surface when developing microelectronic application.

2.5 COORDINATING VLSI TECHNOLOGY AND APPLICATION DEVELOPMENT STRATEGIES

Each developing country visited has a very strong policy toward developing their own VLSI technology base (semiconductor manufacturing). The strategies for developing this base are continuing to be formulated with action being taken in several key areas (such as technology exchange agreements) to implement the strategies. It is obviosly essential to assure that the strategies for VLSI technology development and application development are compatible and complementary. However, there is a strong opion in some sectors in developing countries to FIRST obtain the technology and THEN develop applications using these manufactured components. It is strongly felt by many technical managers in the developing countries, that to EXCLUSIVELY follows this stategy will result in being put on a technology treadmill seriously hampering the introduction of microelectronic applications. It is rather hoped that the policies developed for establishing a base in VLSI technology will be integrated with the policies for developing microelectronic applications to achieve the maximum benefit to the developing country by making the applications competitive in the world markets.

SEMINAR ON DEVELOPMENT OF ELECTRONICS INDUSTRY
IN THAILAND AND IN ESCAP COUNTRIES
16 - 18 NOVEMBER 1981, BANGKOK

SUMMARY AND RECOMMENDATIONS

First day, 16.11.81: Sessions I, II & III

Problems and Prospects of Electronics Industry Development in ESCAP Countries

1. In view of the overwhelming importance of electronics industry for the developing countries of the region, the seminar has provided an ideal and timely opportunity for exchange of ideas and experience among the participants and for finding ways to solve the problems and obstacles for the quick and rapid growth of this industry, especially in Thailand. It has been a valuable exercise towards development of consensus about the concerted and co-operative efforts required for development of domestic electronics industry amongst different agencies and institutions involved in the promotion of electronics industry within the countries and for regional co-operation. The seminar should be followed up with suitable get-togethers, visits and repeat discussions to ensure that the momentum already generated is maintained.

2. The developing countries in the region should strive for a share in the burgeoning market for electronic products and components, through conscious efforts to realize their (countries') full potential in physical, financial, human entrepreneural and technological resources. Towards this end, it is essential to give high priority to electronics industry in the national development plans and to allocate adequate resources to its development. Similarly, an environment conducive for the growth of this industry through suitable financial policies, infrastructure policies, and promotional measures should be created.

3. Electronics industry requires integrated development facilities. Research and development, training of skilled managers and technicians and effective co-ordination between centres of education and research, industrial circles and government agencies are of great importance for the healthy growth of this industry. Mechanisms for such co-ordination and creation integrated development facilities should be created both at the national and regional levels.

4. Since no country can afford to be backward in electronics, every country should aim at an up-to-date and modern electronics industry and use of electronics in all aspects of natural endeavour. This cannot be achieved by following traditional methods, but through devising new strategies after assessing strengths and weaknesses in a given context. These strategies have to be different in different countries. While it may not be necessary for everyone to do everything, the lines and methods of specialization to be followed by any country should be thought out in a hard way. For developing countries, despite the constraints, many opportunities exist in subcontracting, software development, application of electronics in agriculture, agro-industry, office arrangement, health, industry, etc. It is necessary to seek these opportunities and go ahead.

5. The initial steps for the development of electronics industry have to be made in carefully chosen areas with details such as scale of investments, training of technicians and engineers, product-mix and rate of change clearly spelt out in the electronics development plan. A good understanding of international cartels and their control of market, machinery and components is necessary. In the nature of this industry, there are several options for a country such as

/export

export-led growth or domestic-oriented growth, consumer products or industrial products, component imports or local manufacture, decentralized production or centralized production, etc. These options have to be carefully exercised on the basis of the strengths and constraints in a given country and determined effort made on the basis of these choices.

6. The recommendations of the ESCAP/RCTT study team in regard to technological development, promotional institutions and activities, manpower development, entrepreneural development, etc. were noted. The seminar urges early implementation of these recommendations. For this purpose, adequate funds may be provided at the national and regional levels by UNDP, UNIDO, RCTT, and donor countries. The RCTT network of national focal points of electronics could consider the recommendations made by the study team for promotion of the industry in the region and act on them. TCDC activities have to be promoted through workshops, meetings, visits, fellowships, training courses, etc. ESCAP/RCTT should take a lead in this area.

7. The presentation of country experiences by representatives from Bangladesh, Hong Kong, India, Malaysia, Pakistan and Republic of Korea has been interesting and useful in understanding the basic parameters of growth in the electronics industry and the manner in which constraints could be overcome. The institutional and specialist arrangement for development of electronics industry especially in Hong Kong, India, Pakistan and Republic of Korea were specially noted. Facilities for training skilled technicians and organization of short-term training courses in management and production at some of these institutions would be valuable for other countries of the region.

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These may be further discussed and sponsored by RCTT.

8. Strategic decisions regarding transfer of technology, enhancement of domestic design and production facilities and development of export markets made by Hong Kong and Republic of Korea provided valuable insights for drawing plans for development of electronics industry, especially in the area of component and equipment manufacture and for export orientation. The approach adopted by India for self-reliant, geographically decentralized and integrated development was noted. The measures taken by Republic of Korea to lay a firm foundation for production, deal with unsettled condition of technology development, stimulate and stabilize domestic market and cope up with deteriorating environment at international trade were carefully noted. The policies for future development of electronics industry in Hong Kong, Republic of Korea, India and Thailand have also yielded useful information on the nature of exercises for restructuring electronics industry in the countries of the region. There is no automaticity either in technology transfer or in developing domestic or external market. This is always the result of conscious endeavour. Mutual co-operation among developing countries of the region is an important factor in this endeavour.

/Second day

Second day, 17.11.81: Sessions IV, V, VI and VII

Development of the Electronics Industry in Thailand

Presentations and discussions in Sessions IV to VII were primarily upon the development of electronics industry in Thailand. The speakers and penalists were from government agencies, academic institutions and electronics industry in Thailand. Based upon the presentations and discussions the following summary of recommendations for promotional measures emerged.

1. At present, electronics manufacturing in Thailand is mostly concerned with assembly operations. The main manufactured consumer products are radio and television, other consumer products such as sound equipment are produced in small quantity. Telephone and transceiver are the main products in telecommunications, component industry consists of the production of IC, capaciter and radio/television parts. The production of industrial electronics equipment is marginal. With the exception of IC and capacitor, other products are largely for world consumption satisfying about 25% to 50% of the local demand. Thus, there is large unfulfilled potential for the growth of electronics industry in the country.

2. The demand of the current products is generally on the increase. The following new products were considered as those offering good prospects in Thailand at the present juncture.

(i) Telecommunication equipment

(ii) Basic electronics components

(iii) Mini- and micro-computer including software

(iv) Micro-processor-based products

(v) Printed circuits

(vi) Calculator

(vii) Audio equipment

(viii) Television tube especially colour tube.

3. The fifth five-year National Economic and Social Development Plan has set the following objectives for industrial restructuring:

(i) To increase the proportion of value added of manufactured exports from 16% to 25% in 5 years.

(ii) To begin the process of rational import substitution of intermediate products and to develop resource-based industries.

(iii) To increase the proportion of manufacturing value added in areas outside Bangkok and in nearby provinces.

(iv) To increase the proportion of value added of small-scale industries.

The options chosen to develop Thai electronics industry are to promote exports, import substitution of components, manufacturing of consumer product and decentralized production. The electrical and electronics industry would receive the first attention in the restructuring efforts.

4. Main problems facing the industry in Thailand are: rising wage, slow customs clearance, anomalies in tax structure, multiplicity of government agencies dealing with electronics, smuggled goods, dependence on the import of intermediate products, limited market, limited capital, unskilled manpower, low technology, etc.

5. Customs procedures should be streamlined to expedite the import and export of goods and it should be possible to clear the goods in all aspects at one place, i.e. at the port or the airport.

6. Tariff structure needs to be changed in such a way that the overall rate will be lower and more uniform to provide adequate protection while discouraging smuggling. Tax measures may also be used to promote manufacturing in general and manufactured exports and component production in particular.

7. The Board of Investment should serve as a one-step promotional agency.

8. The government may either participate directly or subsidize the most promising entrepreneurs in setting up component factories.

9. Export processing zones are required to be built rapidly especially at the Eastern Seaboard industrial zone.

10. The Ministry of Commerce may increase its efforts in providing local manufacturers with marketing information. The large number of tourists visiting the country could represent an important market. State enterprises and government agencies could offer a secure market for promoting local manufacture by announcing in advance the long-term procurement plan.

11. In the implementation of restructuring of electronics industry, there should be greater support from all financial institutions and commercial banks in providing credits to the manufacturing units. The industrial restructuring policy and the improved credit facilities should be well publicized to encourage industrial restructuring policy and the public participation in capital formation.

12. Systematic manpower training should be included in joint venture contracts or be negotiated with off-shore factory owners. Education institutions are required to revise their curriculum to be more relevant to local industry. A serious effort should be done to

increase the number of electronics technicians. Formal and informal education should better serve to promote entrepreneurship.

13. An institute for electronics research and development needs to be established for instance as a joint private-public institution. The Centre of Technology Transfer, Ministry of Science and Technology and the Ministry of Industry should assist manufacturers regarding the acquisition of basic and/or new technologies. University and research institutes should have better links with the industry. The government should use tax incentives and/or subsidies to promote in-house research.

14. Electronics associations should improve their effectiveness in promoting electronics industry and the establishment of new associations should be encouraged.

15. In order to achieve common objectives set forth in the National Economic and Social Development Plan, all sectors should pool their efforts together. Government agencies should seek better co-ordination and not create their empire, government and private sector should fully co-operate. Private agencies should adopt fair competition and if possible foster link through complementation and subcontracting.

16. Entrepreneurs should be resourceful and innovative especially in electronics area. It is good enough to point at difficulties due to taxation, smuggling or illegal products, for instance, but it is better still to talk about ambitious plan, to conquer new technology and move quickly to new promising products.

Third day, 18.11.1981: Session VIII (09.00-10.30)

Development of Electronics Industry in Thailand (Cont'd)

17. Fluctuations in IC unit prices are noticed. This is due to various factors such as technology improvement, introduction of automatic bonding, stiff competition, etc. It is also noticed that this industry

in Thailand does not contribute significantly to manpower development and technology transfer which are necessary for the long-term development of the industry.

18. The production of telephone sets is much lower than the production capacity and the local demand. Tax structure, bureaucracy and procurement procedure are identified as the main causes of the discrepancy.

19. It is foreseen that the market of the electronics components whose production is to be promoted by the government, will be limited. In addition to various measures to overcome the problem, there should be a genuine co-operation among electronics equipment manufacturers, if the project is to be successful.

20. Efforts should be done to issue license to "illegal" factories, and then to encourage them to contribute constructively and in a dynamic way to industrial development.

21. By combining good marketing and in-house research and development, small and medium firms should develop their capability to move from one product to another in order to remain innovative and competitive with mass production.

22. Thai entrepreneurs should learn more from others' experiences and try to know their competitors.

23. In order to achieve long-term objectives, there should be a serious effort to develop fundamental technologies as well as the production of capital goods.

24. It is a very encouraging that a joint government-private committee to promote electronics industry was set up. The Committee should include experts drawn from academic circles in order to stress the importance of research and development and technology transfer.

Session IX (10.45-12.30)

Transnational Corporations

1. During the discussions on the comprehensive paper upon "Transnational Corporations and the Electronics Industry in the ESCAP Region", presented by ESCAP/UNCTC Joint Unit on Transnational Corporations, the role of TNCs in technology transfer, training of skilled manpower, development of management skills and as providers of export markets was noted.

2. In view of the primary orientation of TNCs towards profits and the capacity and flexibility they enjoy on account of their worldwide operations for optimising profits, each developing country should set out suitable parameters for their functions so as to render their operations conform strictly with national ~~goods~~ goals and policies.

3. Adequate measures to secure the transfer of skills, technical know-how, promotion of local design ability, and growth of indigenous units should be planned and implemented in order to gain any advantage from TNC operations.

Subcontracting

1. With the rapid increase in the number of TNCs and domestic medium and large manufacturing units, subcontracting in electronics has assumed added significance and provides new opportunities.

2. Facilities for training manpower, technological upgradation and for standard · and testing are needed for the growth of efficient sub-contractors. ,

3. Special centres for providing basic technologies and upgradation of existing ones have relevance in this regard.

4. Anomalies regarding double taxation adversely affecting subcontractors need to be eliminated.

Session X (13.30-15.00)

Regional Co-operation

1. The recommendations made by the ESCAP/RCTT study team in their regional study, on organization of programmes and promotional measures by RCTT may be implemented with co-operation from interested countries as soon as possible.

2. The ESCAP/RCTT study team has not covered several countries in the region where policies and achievements have relevance to other developing countries. Therefore the study should be extended to cover these countries also, especially Hong Kong, Republic of Korea, Indonesia and the Philippines. There are countries with no or incipient electronics industry like Nepal where electronics industry possibilities have not been adequately investigated. The ESCAP/RCTT regional study should cover these countries also.

3. In the identification of institutions and facilities for training, exchange of know-how, visits by concerned persons, etc., those in the countries not covered by ESCAP/RCTT study team, but where the electronics industry has succeeded impressively, should also be included.

4. RCTT may obtain and distribute among countries in the region, all studies and reports on electronics from any member country, which may be useful to others. In order to facilitate this, each of the focal points in member countries can nominate one person who can supply information to RCTT regularly and keep RCTT posted with the required data on manufacturing facilities and promotional measures.

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5. RCTT can explore the possibility of organizing combined development of electronic equipment needed by more than one country in the region, upto prototype stage and for sharing of facilities for standardization and testing.

6. Feasibility studies on joint production of electronics items, especially those involving high technology, recommended by ESCAP/RCTT study team need to be carried out so as to concretise the collaboration arrangements and participation in the projects.

7. The area of marketing and market development is especially important, especially development of markets in U.S.A. and Europe for products from the region. This area should be adequately studied so as to identify a core of measures and activities helpful to countries engaged in this task.

8. Co-operative marketing ventures and other common facilities to circumvent specific problems of marketing in the developed world should be thought of. In this connection securing the standards certification through a common agency in U.S.A., U.K. and West Germany may be a possibility. RCTT can bring together concerned production and promotional agencies to explore this possibility.

9. ESCAP/RCTT may explore other measures to strengthen national manufacturers' associations in electronics and also initiate activities to form a regional electronics industry association as a complement to its network of focal points. Such an association would be a valuable contribution in planning joint projects, common facilities and in organizing trade shows, etc., which are important for market development.

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GOVERNMENT OF INDIA

PROJECT INTERACT

International Education and Research

for

Applications of Computer Technology

Executed by : Computer Maintenance Corporation Limited
(A Government of India Enterprise)

Funded by : United Nations Financing System for
Science and Technology for Development (UNFSST)
and India Country IPF

The following pages contain a summary of the proposal made by the Government of India and accepted by UNIFSTD (now known as UNFSST) & UNDP for a computer technology development and training programme. The summary contains a description of :

- development objectives
- immediate objectives
- special considerations
- background & need
- methodology for research and training
- outputs
- inputs
- typical application areas

The project is being executed by Computer Maintenance Corporation Limited (CMC) on behalf of the Government of India. The project commenced on May 1, 1981 and is planned to be completed by December, 1984. For further details on the project, especially with reference to technical cooperation among developing countries, please contact:

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THE PROJECT

Development Objectives

This proposal defines a technology development and training programme (TDTP) to develop and transfer technical know-how in systems integration and engineering of small, computer-based systems dedicated to applications which are essential to build up and support development-oriented activities in a number of areas.

A partial list of typical application areas of high priority, such as, communication, power systems management, wagon-movement management systems, early-warning systems, non-linear language systems, is given in Annexure I.

Under this project, it is proposed that reconfigurable prototypes for dedicated computer-based systems would be systems engineered for applications in areas such as power systems, wagon control, transportation, weather forecasting, and for information dissemination applications such as text handling, editing, etc. These systems would have immediate relevance to various different national agencies and organizations, viz. Electricity Authority, National Railways, Meteorological Department, Civil Aviation, Education Departments. Steps will be taken to ensure that with minor modifications, these systems can cater to the local environmental conditions of many developing countries.

TCDC

The development objectives are based on a philosophy of pooling of experiences, of sharing of benefits among developing countries, innovative project design and implementation methods for the strengthening of the indigenous scientific and technological capabilities and international cooperation among developing countries.

It is within this framework that the Government of India proposes to IFSTD to support this project which would enable developing countries to build up the necessary infrastructure of qualified personnel and technical capabilities in the computer areas, to systems design, engineer and integrate dedicated computer-based systems. The programme would be undertaken on the basis of technical cooperation among developing countries (TCDC). Recognizing the importance of this programme, and the equal importance of undertaking it in a TCDC mode, the Government of India is providing US $ 600,000 of the 10% of its IPF that it pledged at the Buenos Aires Conference to commit to TCDC.

Immediate Objective

The immediate objectives for establishing the TDTP under this project are :

1. To develop consciousness to a systems integration approach for computer-based applications.

2. To develop software and system design and integrate hardware for computer-based systems to demonstrate systems for controlling, monitoring and handling power grid systems, railway wagon control systems, communication and information systems, photo-composing systems for non-linear scripts, and early-warning systems.

3. To train personnel in systems integration methods as applied to dedicated computer-based systems.

4. Disseminate technical information on both hardware and software as developed during the project to developing countries.

All the applications detailed here have a switching-cum-data communication system as the core. A significant part of the basic technology, expertise and experience developed here will be of direct relevance to the proposed Development Information Network (DIN). Therefore, during the currency of this programme, if IFSTD/UNDP so desires and if the Government of India agrees, emphasis could also be directed to the requirements of DIN.

Detailed activities through which the above objectives are to be accomplished, would be identified within 5 months of the project approval.

D. Background and Need

Relevance of dedicated computer-based systems

Most of the industrialised countries are now working with dedicated computer-based systems, both real-time and off-line. These are powerful but expensive. Of the cost of a dedicated computer-based system, it may be estimated that approximately 40% is for the hardware and 60% for the software and other support cost including installation/commissioning, warranty maintenance, training, etc.

These dedicated systems are based on the integration of computer segments, communication segments and monitoring and control segments. Today, most such systems are provided only by suppliers from a few industrialised countries and that too on a turnkey basis. As a result, developing countries have no option but to import such systems, often as "packaged black boxes". For example, India, today, spends about US $ 20 million annually on importing such systems. Other developing countries also are increasingly spending similar amounts on such systems. This has created an urgent need for (a) technology developing (R & D) in systems integration, design, engineering, and (b) programmes to train scientific and technical personnel in developing countries for such computer-based systems for use in the application areas indicated earlier.

To meet its needs for such systems a developing country like India must choose one of the following options:

- Import on turnkey basis
- Manufacture hardware
- Systems integrate internationally and locally available components

The practical solution for many developing countries would be to select the third option, since infrastructure and technical manpower resources already exist, investment is low and local manufacturing can also be complemented, through such an option.

As described above, it is evident that there is a great need for India and other developing countries to build up competence in the technology of computer-based systems, on a coordinated and collaborative basis. Considering that after excluding electronic data processing and data bank applications, around 1% of the industrial investment in the eighties anywhere may be on computer-based systems of the type described here, the initiative proposed is very significant. Developing countries are usually disadvantaged with respect to the interfacing of instrumentation and equipment to computers since most equipment and software is imported. As a result, absence of expertise in this technology will progressively preclude developing countries from the area of design and production of all types of engineering goods including products such as machine tools, boilers, power system equipment, since all such equipment will be designed with computer control as an inherent feature. Hence, to achieve self-reliance, give impetus to the local down-stream instrumentation industry and reduce dependence on foreign technology, India and other developing countries must start development work in this area immediately.

Special Considerations

As identified in the development objectives, the TDTP envisaged in this project will place very heavy emphasis on technical cooperation with other developing countries from Central and Latin America, Africa, Arab states, Asia and the Pacific, in the following manner:

1. Professionals and experts from these countries would help to identify specific country needs for developing relevant computer-based systems in the application areas set out in the Development Objectives.

2. Computer professionals from these countries would work in the areas of systems analysis, design and systems integration as co-workers and partners along with professionals from India. These co-professionals, at the end of their assignment would be fully equipped to undertake such tasks on their own, as well as imparting training to others, in their country.

3. Of the 200 personnel to be trained in all aspects of dedicated computer-based systems (see Outputs), approximately 100 participants would be from the regions listed above. The participants would be drawn from identified target groups which are potential users of such systems and the training would be generic in its approach. Therefore, by the end of the training programme, these participants would have a clear understanding of the hardware and software involved in real-time computer systems.

The professionals from the other developing countries as well as the trainees would be sponsored under a separate project under the Umbrella TCDC Agreement. In addition, CMC would ensure that the expertise available with the National Centre for Software Development and Computing Techniques (NCSDCT), the National Informatics Centre (NIC), the various Indian Institutes of Technology, universities, management institutions, and other national organisations is utilised to provide guidance for this project.

Methodology

Approach to research and development

1. Research and development would cover design, development and realistic testing of computer-based systems involving systems engineering and software efforts.

2. Technology development would be linked to time-bound projects whose goals would be the realization of specific systems based upon actual user needs.

3. During the course of such research, specific consultancy advisory services would be provided on actual cost basis to requesting organizations in developing countries in the area of such dedicated computer-based systems.

4. A close link would exist between research and development and training activities. It is essential that the same staff should be involved in both activities, sharing their time appropriately, to ensure high credibility of teachers, their close contact with the systems being developed and a high level of professional competence among the teachers.

5. There would be an emphasis on modularisation and written specification of technical activity. Adequate care would be taken, managerially, to dovetail the work of several professionals into an overall pattern, keeping individual accountability at a high level.

Approach to training

1. It is anticipated that the trainees would be drawn from developing countries from Central and Latin America, Africa, Arab states, Asia and the Pacific.

2. The trainees should have the following minimum qualifications:

   i) Degree or equivalent qualification in Electronic or Electrical or Telecommunication engineering. Trainees with diplomas but having sufficient experience could also be covered.

   ii) A minimum of 2 years' experience in computer programming or computer hardware design or maintenance.

3. In view of technical considerations, all training would be in English. For those few trainees who are not familiar with English, special arrangements would need to be made by drawing upon existing training arrangements elsewhere, to give them functional knowledge of English.

4. Twelve-week intensive courses would be the basic units of training. A few of the courses planned have been listed below:

- real-time systems design and implementation hardware and software interfacing of computers in real-time systems
- operating systems for real time applications
- real-time applications (power, wagon control and communication)
- non-linear scripts
- computer maintenance

Each batch would have around 20 participants divided into groups depending upon the number of courses being conducted in parallel. It is visualised that several courses will run in parallel, each requiring one-half of participant time each day. On the basis of pre-course test performance, participants would be advised to enroll for one, two or three courses in parallel.

5. Creation of course materials, particularly in the form of books and lecture notes will be given importance. Trainees would invariably take back with them adequate documentation to stay in touch with what they learnt. Course materials in the form of visuals for use in teaching elsewhere and in the form of instructional computer programmes would also be produced where appropriate.

6. It is anticipated that the course materials produced would be used by participants to teach others in their place of work; this will be kept in mind while preparing the course materials.

Outputs

The main output of the project would be the competence building of the countries involved, including India, in the area of systems design, software development and systems integration of real-time and other dedicated computer-based systems and the expertise to provide technical and economic assistance to various national organizations.

The other outputs of the project would be:

1. Professionals with competence and experience in integrating special purpose systems for applications listed earlier.

2. Integration of one fully duplexed system based on two mini-computers with a microprocessor as front-end processor. This system will be the basic unit for communications, wagon-movement systems, power systems, early-warning systems and applications relating to non-linear languages.

3. Prototypes of dedicated hardware/software including related sensing, telemetry, transmission and display equipment for specific applications.

4. Training of 200 personnel in the know-how generated.

5. Training materials consisting of course materials, documentation and teaching aids for use in training organizations in developing countries.

6. Dissemination of results through:

   a. Technical reports/monographs
   b. Seminars/workshops

After the project is over, CMC would continue to undertake activities at its research and training complex with the following objectives in mind:

a. To transfer technology developed under the project to professionals and trainees of other developing countries.

b. To assist other developing countries in establishing and managing different centres based on dedicated computer-based systems.

c. To run training programmes for Indian organizations.

Inputs

1. Description of Government counterpart contribution in kind

In addition to the assignment of national staff, the Government would provide equipment, buildings and various miscellaneous expenditure for this project. The total amount committed under this head would be Rs. 4,306,000. The amount allocated for TCDC, which is that portion of the efforts of the national staff and portion of the equipment, building, supplies that would be utilized for the TCDC project, amount to Rs. 1,290,000. This amount of Rs. 1,290,000 is not over and above, but a part of the total commitment of Rs. 4,306,000 by the Government of India for the TDTP/TCDC projects.

2. Description of inputs from other developing countries

a. Salary of the co-professionals selected for participation in technology development and preparation of training programmes.

b. Salary of the trainee fellows nominated by the developing countries for attending the training courses at Hyderabad

3. Description of India Country IPF inputs

	Cost (in US dollars)
a. 25 Co-professionals @ $ 8500 per appointment	212,500
- Airfare @ 2000	
- Expenses including housing @ $ 4500 for 6 months ($ 25/day)	
- Stipends/honorarium @ $ 2000	

		Cost (in US dollars)
b.	100 Trainee Fellows @ $ 3800 per appointment	380,000
	- Airfare @ $ 2000	
	- Expenses including housing @ $ 1800 for 3 months ($ 20/day)	
c.	Miscellaneous	7,500
	TOTAL	600,000

4. Description of IFSTO Inputs

In addition to the assignment of expert staff, the IFSTO would provide all hardware equipment (both expendable and non-expendable), as well as training for hardware/software engineers. The total amount committed under this head would be US $ 1,590,000.

ANNEXURE I

PARTIAL LIST OF TYPICAL

APPLICATION AREAS

Communication

For the coordination of activities and management of resources in a geographically dispersed area, 'data communication' forms a very vital link. This is crucial for procurement and distribution of essential goods, meteorological services, water resources management and even administrative management. The communication system should be capable of handling textual as well as value data. This would require building up of data communication network, terminal and front-end processing. For all the special applications different types of front-end processors, terminals and associated software would be developed. The communication systems envisaged are for switching messages, for data communication between two processors, data communication between terminals and computers. The communication system will be the backbone for these applications and other applications mentioned subsequently.

Power Systems Management

There is a need to monitor the information from various power stations of a region at a central location to ensure proper distribution and economic load despatch. A computer system at the regional headquarters, would acquire the telemetered measurands from the constituent power stations through front-end processors. The front-end processors would perform limit checking, display, driving and conversion of engineering units thereby relieving the main processor of elementary processing. Information regarding reservoir levels, coal and oil reserves, would be fed through terminals at site. Based on the information thus acquired, the central computer would compute coincident demands, system losses, system reserves and system generation on a daily and monthly basis. In addition, event logs, freezing of instantaneous information for events and creation of long term data base would be accomplished.

Wagon Movement Management Systems

The need to improve the movement of critical material like coal, oil, foodgrains, etc. within a country is of paramount importance. Currently in India, the turnaround time for a wagon is about 14.3 days. Based on statistics available, if one day out of this time is saved, about 29,500 wagons per day would be generated.

This is approximately equal to US $ 335 million of rolling stock. Urgent action is therefore required to develop a dedicated system for control of wagons at large junctions.

Early Warning System for Flood and Rain Forecasting

The extent of damage caused by floods, drought, cyclone tides and other such vagaries of nature, in developing countries is extremely high. In most such cases the damage can be reduced considerably if warning is given in advance.

The development activity planned in this area would include integration of suitable sensors to collect data on various parameters like rainfall, water level, tides, which would be fed to the system through a front-end processor. The data would be processed to provide early warning on a continuous basis.

The system would also provide for statistical analysis of data collected over a period of time, which would be used for an archieval reference for long range forecasting.

Non-Linear Scripts - Computer-Based Photocomposing Technology

The advances made in computers and information processing have not significantly benefitted communication and typesetting in non-linear scripts. There are a number of languages for which a common photo-composing technology would be applicable. They have far more complex sets of characters than the Roman Script, but smaller sets than that of Japanese or Chinese. Instead of using only independent, linearly additive characters (as the Roman Script does), these scripts use a variety of diacritic marks which need to be appended to characters on the left or right as well as the top or the bottom. They use 'half characters' which can be combined to form compounds. All this complexity has to be mastered in a systematic manner if effective general solutions are to be found for performing practical valuable data handling operations on these scripts. Segmentation of characters, coding, sc ting techniques, keyboard, hardcopy printer and display design are significant tasks in this area.

It is worth noting that equipment for handling certain non-linear scripts is commercially available in a limited way. But the technology is in need of development. No standard codes or inputs/

output equipment are available for handling most scripts. Very often one finds that typesetting equipment meant to handle a script like Devanagari (a script commonly used for Hindi) is useless for educational publication - it lacks mathematical symbols, subscripts, superscripts, etc. A major effort is necessary to create and disseminate necessary know-how and standards, and to meet the requirements of the following:

- Publication of books and periodicals
- Literacy improvement programs
- Word processing and typesetting

The technology described here will have utility for many countries other than India, and will be applicable in a number of nations from Turkey to Vietnam, though at this stage, specific languages are yet to be analysed.

THIS IS NOT AN EXHAUSTIVE LIST OF APPLICATIONS.

Mr. GORE. Thank you. You have discovered our hidden agenda for the hearing this morning; that summarizes it pretty well.

Mr. Goldhaber, welcome; we will hear from you now.

STATEMENT OF MICHAEL GOLDHABER, INSTITUTE FOR POLICY STUDIES

Mr. GOLDHABER. Thanks for the opportunity to speak to the committee. One advantage of speaking last is that one gets to experience the hunger pangs which are so common in the Third World—problems we are addressing.

I will summarize some of the points in my statement that I think bear upon some of the issues that were raised in the discussions so far.

First of all, I would like to put a perspective on the whole development problem, which is to say that what we are dealing with here are certain inevitabilities. Essentially none of the countries of the world at this point can escape from the existence of highly industrialized advanced civilization and its impact upon them.

In addition, I think it is inevitable that the interrelationship between countries is going to increase. The kinds of connections which new communications, and new transportation technologies as well, permit mean that more and more the world will be operating as an economic whole.

An implication of that is that developing countries find themselves in the situation that, if they import capital by any means other than outright grants, they have somehow to pay for it despite the fact that their average per capita productivity is far lower than that of the United States or other developed countries.

Therefore, what the developing countries have to do somehow is squeeze some sector of their economy in order to be able to pay off the capital which they have purchased. They do this in a variety of ways. One way is to have very cheap labor. Another way is that less successful farmers get pushed off the farms in a process very similar to what happened in the developed nations a couple of cen-

turies ago, except that it is happening in an accelerating rate in the developing countries at a time when their populations also are extremely higher than the populations were in the developed world a few centuries ago.

The result of all that is a huge degree of pain, for one thing, in the developing countries and a huge degree of cultural loss. Many of their cultures are highly specific to a certain mode of life. As they, for instance, are forced to move in large numbers into the cities, very much of their cultures cease to be applicable as any kind of guide to a way to live or provide any kind of social fabric with any sort of unity. The results are very serious for these countries.

One result is the creation of a very large and very impoverished work force. Because the United States and other developed countries are increasingly linked with those countries in one economic system, the overall result is that we too face the ultimate danger that our own work force, in order to compete successfully, is going to have to operate at a lower and lower standard of living.

Therefore, our concerns with the problems of development should not be viewed as idealistic. They are exceedingly pragmatic from the standpoint of the population of the United States itself, in terms of a period that possibly is extending through the next few decades.

Into that situation comes the microprocessor, and that presents a third kind of inevitability. New technology is certainly going to reach those countries. Technology transfer, whether we like it or not, occurs in one form or another when it is commercially viable, and it might turn out to be commercially viable in the form of some pocket computer 50 years hence. The time scale is a little hard to estimate, but we can take it for granted that sooner or later microcomputer technology is going to arrive, possibly in a very helter-skelter way, in these cultures.

The question is then, is there some way that we can shape and control the way in which that new technology arrives in those countries and the kind of impact that it has? Second, is there some way in which it might be looked at as some sort of hopeful or beneficial change?

I think if it just comes purely on a commercial basis, no matter how much goodwill there is on the part of the various enterprises eager to sell their products, we will see the same sort of variable results, at worst, as we have seen in such instances as the notorious case of infant formula or perhaps more appropriately the arms trade—namely that in many cases the technology will be very badly misapplied. It will turn out to be to the detriment of perhaps all concerned.

But on the other hand, I think there are some reasons for hope if we proceed according to some sort of clear understanding of what is possible and what desirable goals are. The reason for that hope is precisely that there is not a large market for microprocessors in the Third World countries because, for the reasons I have indicated, there is not a market at all. Many of these countries are in fact in debt at this point, and they look likely to get into further debt. They are unable to meet their interest payments in many cases at

this point. To see them as importers of new technology on a large scale and as vast new markets is improbable.

However, the microprocessor does have the advantage of being itself very cheap; so that the major costs involved with microprocessor technology—and this will be true increasingly, I believe—are in the development of software.

I think there is little reason why a large number of developing countries, if not all of them, cannot develop their own software potential. This means undercutting a potential market from the United States, but I think that is ultimately to the U.S. advantage—namely, if these countries are able to leap the barrier involved in producing their own software to meet their own needs in their own form, they can achieve a kind of degree of comparability or even equality with the developed countries without going through the process of achieving industrial equality. That is largely because, at the same time as the Third World will be changing, the developed countries are also changing in the direction of becoming an information-centered economy.

An information-centered economy does not mean that people cease to eat, it should be stressed; it means that the problems of agriculture, for example, become somewhat subordinate to the main interests and focus of life.

How can that happen in a developing country where at this point people in many cases do not eat well enough at all even to be able to use a computer for instance? I do not want to provide the impression that I think of microcomputers as a panacea. On the other hand, it is clear that they offer, if they are integrated into a communications network, an extremely powerful means of coordination which can mean a tremendous range of economic possibilities in the old sense of "economic"—in the sense, for instance, that food need much less go to waste; it can be better distributed. New techniques can be passed from one village or one part of the society to another part, and there is the possibility of obtaining information from the developed countries in a way that will make it useful to them, and that has already been discussed.

So I think that, as a tool—perhaps the word "tool" is wrong, as we have seen—but in some sense as a new way of organizing society, microprocessors have a lot to offer economically to developing countries. They also have a lot to offer culturally in the sense that they are exceedingly flexible, in principle at least, in the way they are programed. They are decentralized in their nature. Both of those things mean that decentralized cultures have a better chance of surviving without being totally altered or ripped apart. The cultures will change substantially, but they can at the same time make use of computer software which is adjusted to the particular culture—to the indigenous ways of thinking—to a significant extent, so that various aspects of the culture, hopefully, can survive.

But I want to emphasize here that there is no kind of change or development in any significant sort which does not bring with it cultural problems and cultural change that are indeed major problems which must be looked at.

In particular, let me emphasize the problem of dealing with a new technology when one's basic outlook on the world is perhaps

not technological at all. We are all familiar with the recent example of the successful use by the Ayatollah Khomeini, who represents in some ways a very ancient culture, of modern technologies such as cassette tapes and later, once he was in power, television as a means of controlling and influencing policy in a direction completely opposite to the sort of rational basis which we have perhaps assumed underlies technology and which goes with "enlightenment" culture altogether.

Mr. GORE. And direct dialing as well, which was immediately suspended after he seized power.

Mr. GOLDHABER. Yes.

There are many examples one can give of this kind of use of modern technology by people whose outlook is quite different. It is extremely easy to use anything up to and including probably a cruise missile without having any understanding of how it works or having similar outlooks.

I think that we have to avoid any kind of arrogance in assuming that our outlook is always sufficient to our use of technology, but I think the problems can be even larger in developing countries.

It is difficult to give examples of direct ways in which microprocessors can be misused, but the reason that they present a problem is: First of all, it is impossible by looking at one to figure out how it works at all. The rationality that stands behind it does not go with it—does not travel with it at all.

Second, it can be programed in such a way that it can be used without even understanding any kind of programing language or any particular form of logic, possibly even so that it could be used by illiterates, for instance, possibly even so that it could be used through oral communications. We already have microprocessors in this country of course which talk back to you. We have yet fortunately to achieve those to which you can directly talk.

But for a country which still believes perhaps in gods and spirits the problem is quite severe. The way microcomputer will fit into the culture is very different from the way they fit into our culture.

We have to find a way somehow, it seems to me, to pay attention to this kind of problem while we try at the same time to see that the benefits of these technologies reach the peoples of the developing world.

I think that points to the need for a center somewhat on the French lines, although I would describe the scope more broadly. It should be particularly concerned with utilizing microcomputers for coordination as well as for education. I think that one thing that the center ought to be doing is very carefully monitoring what the effects of microprocessors and new communications technology in general are, and I would say not only in the Third World but even here in the United States as well where that remains a big problem without sufficient attention.

Another thing that a center should do—and possibly this should be a separate center—is call for those particular technological developments which would be unlikely to occur in the normal course of commercial development. That might mean, for instance, possibly expensive development of the kind of technology which will permit relatively cheap communication between microprocessor-

based computer systems on site in the Third World countries that possibly lack an electrical power grid and so forth.

So there are very many technological problems. I have tried to list some of them and, very pretentiously, also to list what I saw as possibly some solutions in my first appendix. But what I want to emphasize is that, if these benefits can accrue from microprocessors, then I think it is important to get started in the relatively near future and seriously to think about a center such as the one you have discussed and to begin to implement some of the goals.

Thank you. I would be pleased to answer any questions you may have.

[The prepared statement of Mr. Goldhaber follows:]

99-819 O—82——12

July 12, 1982

Prepared Statement by Michael Goldhaber

For delivery in the Joint Hearing of the Subcommittees on Investigation and Oversight and on Science, Research and Technology of the House Committee on Science and Technology on the Transfer of Microprocessing and Information Technology to Developing Nations, July 15, 1982.

As a starting premise, I would suggest that it is nearly inevitable that in time microprocessor based computer systems will infiltrate everywhere in the developing world. The question then is really whether there are advantages in attempting to coordinate and shape the way this technology transfer occurs. I think there are decided advantages relating to economic equality and cultural survival.

The developing nations as a whole face enormous difficulties. In order to develop they must import capital goods from the advanced countries, and must find a way to pay for these goods with per capita national incomes far lower than in the West. The only way to do this is to impoverish large portions of their populace still further. In addition, to make use of these capital goods they have to alter longstanding social, cultural and geographic arrangements. One consequences has been the enormous growth of third world cities, which have become very largely cities of the poor, with only a veneer of culture surviving.

But if development presents a grim prospect, at this point refusing to develop is still grimmer. Burgeoning population alone means that old ways of life can no longer be sustained. Thus the developing nations face economic problems and cultural decay which will translate to great suffering for many, if not most, of their citizens.

Now comes the microprocessor. Since microcomputers show every sign of helping foster economic and cultural instability even in the advanced societies that invented them, why should they hold out any hope for the developing countries? At first sight it would seem likely that microprocessors would merely make matters worse, adding to the overall burden. Indeed, if these devices are introduced by commercial forces alone, I think they will add to the chaos. But if they are introduced with appropriate reflection and forethought

I am convinced there is some reason for hope.

In the economic sphere the transformation to a computer-based information-centered economy permits new degrees of equality between the first and third worlds. An ever larger percentage of capital is taking the form of software and information as opposed to machinery. It would be far easier for developing companies to produce their own software than to produce their own precision machinery. Thus, they would be in a position to produce needed capital at relatively low cost. While the advanced countries have a near monopoly on many categories of information, there is less and less material reason for this scarcity to continue. It is increasingly easy to design the technology necessary for the first world to make its data bases freely available to the third world.

A widely distributed microcomputer network could also facilitate economic coordination and cooperation among rural villages. This would permit wiser and more efficient use of available resources and directly improve the standard of living. Finally cheap microelectronic systems could be developed that would serve as sophisticated feedback controls to permit homemade machinery to function as well as high-precision high technology machinery made of complex alloys which now must be imported at great expense.

Cultural survival could also be aided by careful implementation of microprocessor-based systems. For instance, social and economic coordination by means of a microcomputer network does not require centralization. Therefore, existing decentralized cultures would have a much better chance of survival. Development could augment rather than oppose traditional patterns. Further, computer software is in principle sufficiently flexible that usable programs can be made to conform in many ways to indigenous styles of thinking. Computerization would still surely have a major cultural impact but it could be enriching rather than destructive.

If the introduction of microprocessors can be this beneficial, then the sooner it can happen the better. But all these positive uses would depend upon special new technological development, both of hardware and of software. There would have to be suitable arrangements for training and for collecting and distributing information. A program to achieve these ends would encounter significant political difficulties in distributing computer power more widely than to entrenched elites. Numerous cultural problems arising through computerization would require careful and ingenious solutions, both political and computational. These reasons among others point to the need for a generously funded center or centers, employing not only first rate computer scientists and engineers but social scientists and humanists familiar with the problems of and committed to the well-being of the various peoples of the

developing world. They would have the difficult and delicate tasks of assuring the existence of technological components according with the sort of economic and cultural possibilities I have just outlined. In addition they would have to monitor progress carefully to make sure the program was having desirable consequences. I suggest that the U.S. should seriously consider rapidly setting up a generously funded center, collaborating with the French and with international agencies.

One sort of problem such a center would have to reckon with has to do with the danger of incommensurate elements of different cultures. Modern technology developed in the mental environment of Western rationality. This rationality at least holds out the hope of enlightened treatment of other human beings according to such principles as equality of rights, democracy, freedom of inquiry and the like. On the other hand, technology has often been used to further irrational ends. Hitler, for example, believed in astrology and witchcraft but applied Germany's rationalistic bureaucracy and technology to his irrational goal of genocide. Khomeini's Iran affords a more current example of technology applied for irrational purposes. Microprocessors especially lend themselves to such misuse. It is impossible to learn the rational principles upon which they work by taking one apart, as one could with an old-fashioned watch. Because of microcomputers' capacity to respond to complex commands (including in the near future even some spoken commands) they appear to be animate and easily might come to be considered gods or spirits. Cultures very different from our own might make use of microprocessors without any change in values or world view and thus with no adequate means to understand what they were doing. The results could be disastrous. It would be incumbent upon the center I have described to find ways of forestalling such disasters without simply imposing western culture. One approach to this problem would involve designing introductory programs in such a way that in learning to use the devices, users would have to grasp certain key concepts such as causality.

So far, I have not stated why I believe the U.S. in particular should establish the sort of center I have described. Two obvious reasons are our leadership in microprocessors and in the world economy which together give us both capability and obligation. Another important reason is that we now pay insufficient attention to the ways computers are altering our own society, our own culture. yet the changes discussed here are changes in the entire world order which will affect us too. The center ought also to focus on our needs and problems; for example we ought to be concerned with equality of information access in our central cities as well as In Bangladesh.

Administratively, the center ought to have several components, so that those who monitor and evaluate results and implications do not have a vested

interest in particular programs. In addition the center should cosponsor several major autonomous centers within the developing world.

I believe that what I have offered here differs from the French program in several fundamental ways. First I have emphasized coordination as a computer function at least as important as educational functions. Secondly, I emphasize the significance of cultural and political difficulties which must be dealt with; therefore evaluation and monitoring become critically important. Third, important as I think this program is I would stress that at best it must be approached with only cautious optimism and not with extravagant faith.

Finally, it ought to be clear that the center I am proposing will be engaged in planning, and "planning", often for good reason, has become a dirty word. Let me emphasize therefore that the type of planning envisaged is not rigid, centralized planning. It is rather planning for effective, democratic decentralization--planning for flexibility, not rigidity. It is a kind of planning only made possible by the nature of the microtechnology on which it would operate--variable, powerful, rich in potentiality and promise.

Michael Goldhaber directs the new Science-Values Synthesis Program at the Institute for Policy Studies in Washington, D.C. and is currently a visiting lecturer in Physics at the University of California in Berkeley. Trained at Harvard and Stanford in theoretical physics of particles and fields, he has long been concerned with the social interconnections of science and technology. He was a founder of Science for the People and has served on the Council of the Federation of American Scientists. Since 1977 he has been especially interested in the social, political and economic implications of microelectronic technolgy and has written a number of articles on the subject. In 1980 he began to focus on the impact microprocessors could have on international problems.

Appendix A

New Technology Necessary to Achieve Desired Goals

In the left-hand column, I have listed some desirable goals for the program discussed in the text. In the facing right-hand column I suggest some technological developments necessary to meet these goals. The Center should coordinate such development.

Equality of Access	Computer system cheap enough to be universally available: flat, simple screens, solid state memory, low power radio or infrared transmission capability.
Use in tropical and desert environments	Cheap solar cells, built in heat dissipation, seals against high humidity, insects, etc.
Multi-language information access) Languages appropriate to culture)	Programs to translate information into appropriate graphic displays. Inexpensive means of entering commands orally or from display.
Solution to problem of mixing incompatible cultures (Irrational use of technology)	Appropriate introductory and educational software, continual monitoring.
Non-heirerarchial, decentralized, democratic system	Numerous separate, independently operating units, with communication-network-switching itself part of each unit so that centralized takeover is impossible.
Replace precision machinery	Cheap microelectronic sensors, cheap reliable motors, appropriate software, high-speed microprocessors.
Repairability or cheap replacement	Cheap components, properly designed connectors.
Locally produced software	Features already mentioned should permit this.
Ability to add to or criticize existing information	Two-way communication with advanced countries' information network: satellite hookups and systems compatibility.
Cultural survival	Software appropriate to enter and retrieve wide variety of different forms of knowledge; expert systems.

Appendix B

Information-Centered Society Compared With Commodity-Based Society

Social Category	Commodity Society	Information Society
Daily Activity	Manufacture, Sales, Use of Material Goods and Services	Creation and Exchange of Ideas
Social Value Scale	Prices and Wages in Terms of Money	Meaning and Importance of Ideas Cannot Be Measured
Limits to Distribution of Social Product	Profitability, Limited or Scarce Resources	No Need for Limits Except Inability to Grasp Ideas
Social Value of Individuals	Measured by Salary or Wealth	Much Harder to Measure; Depends on Reception of Attempts at Self-expression
Ease and Naturalness of Denoting Private Property	Ease to Say Which Material Objects Belong to Whom	Difficult to Place Bounds or State Ownership of Ideas
Goal of Productive Acts	Sale of Product or Service or Wages	Recognition and Response from Others
Largest Social Problem	Poverty and Its Consequences	Inability to Gain Audience and Its Consequences
Cultural Form	"Mass Culture" Typified by Common Mass-produced Commodities	Cultural Diversity; Sub-cultures Provide Framework for Social Meaning
Characteristic Knowledge Form	Science and Technology	Science of Meaning, Semiotics, Cognitive Science, Artifical Intelligence, Philosophy, Diverse Myths

Mr. GORE. Thank you very much, Dr. Oliphant, for your very fine statement, and you also, Dr. Goldhaber.

Your statements contained concrete suggestions about how this kind of policy could be carried out. Mr. Oliphant, do you think that the Government is currently paying sufficient attention to this potential and to this issue, or are we a long way off from where we should be in the effort to figure out how to address the problem?

Mr. OLIPHANT. No, sir, I do not believe it is insufficient at all, the attention that is being paid. The mere existence of this hearing, if you will, demonstrates that to me personally.

It is a much more difficult question to answer, what form that participation should take. All of the progress in microelectronics development has occurred, at least in the United States, in the private sector, but I feel that issues being raised—issues that are in the press routinely regarding competition, specifically Japanese competition—need to be addressed at governmental levels.

Issues such as the use and the distribution, if you will, or the "transfer" of microelectronic technology to developing countries also needs to be addressed at governmental levels, but as I stated earlier, I believe in addressing those issues. The Government can most effectively address them by setting broad policy guidelines for private enterprise to attempt solutions to that, and it should be ongoing. I would not expect a hearing such as this to be the end result at all, but indeed an ongoing policy over the next many years.

Mr. GORE. You mentioned in your statement that you think industry is insufficiently aware of the opportunities in the Third World with respect to this technology and to the happy coincidence of an effort to exploit that market and the possibility of using the technology to solve many of the problems that it can be used to solve.

How do you make industry more aware of that challenge?

Mr. OLIPHANT. I believe I understand the question. I hope my remark is not taken negatively, especially regarding private enterprise. I am very much in favor of private enterprise, but what motivates private enterprise is the monetary return that you are going to get from your invested capital and research dollar.

If you take a look at most of the semiconductor companies, in my opinion—I do not have the figures—the opportunities for the market in developing countries is very small; it is a very small percentage of their business. All of us in private industry are extremely strapped for technical resources, for monetary resources. We will put those resources where there is the highest return.

What I think can be done is this: Developing countries do have a vast potential market—and I emphasize "potential." If we take as an objective to, let me say, give the technology to them because of humanitarian reasons, to give them the technology so they can come up by their bootstraps, I believe that will fail, because there will be no economic backbone to it; there will be nothing other than the levitating, if you will, of one technology from the United States to another country. It needs something to sustain it. That something is the economic factors of the applications.

The economic factors, even in developing countries—especially in developing countries—are there. They need to be exploited—and I

use that term very positively—by the developing countries. Applications in agriculture that will greatly enhance or have the potential to greatly enhance their productivity, that have the potential to feed their own people as opposed to depending upon outside resources are markedly improved. Their potential for more effective electric distribution is enhanced. So it is the markets that the developing countries could be and should be developing internally that will provide the strength for the applications that they will develop.

I hope I have answered your question.

Mr. GORE. Yes, you did; you sure did. It raises another question though. You say the concern is to get the highest return on the capital invested. It is an old issue, but over what timeframe? I am not puzzled as to what the answer is, because, as you know, there has been a lot of discussion about our focus on a very short timeframe here in the United States, and it seems to me that one role Government ought to figure out how to play is to expand that timeframe that companies look at by removing whatever factors are forcing them to concentrate on a very short period of time during which they must get a certain return or else die in the marketplace.

Mr. OLIPHANT. Mr. Chairman, I think you absolutely put your finger on something that is of critical importance to the microelectronic industry in the United States. That is, putting policies in place that encourage looking at the long term.

The company that I am with—although I cannot represent them on the statement—we have, as most companies do in the semiconductor industry, long range plans, looking out 5 years and more and trying to project what is going to happen. We commit enormous resources that have an effect, that, if they do not pan out, can be disastrous to the company. And we have also the short-term plans.

When we look at markets, we look at both the long and short range, but we look especially at where we get the money to fund the long range, and that money comes from profit, and then we will make decisions to maximize our source of R&D funds which are profit.

Encouraging that private industry to look further out would be of enormous benefit, not only to developing countries in the long run but to the U.S. competitive advantage I think. I do believe that is a key issue that you have raised.

Mr. GORE. I was driving to work this morning, and the radio announcer said, "We have got two things that every investor must be interested in: high interest rates and short-term—91-day, highest rate." Well, it is hard for Intel to plan for the 10-year introduction of microcomputer technology in some developing markets that you are cultivating when you have to compete in that kind of environment.

Did you want to comment on that, Mr. Goldhaber?

Mr. GOLDHABER. Let me just comment briefly. It is of course true that the microprocessor industry developed through private enterprise, but we should remember that there were large Government programs involved along the way. Looking around us, the walls of the hearing room are covered with memorabilia of the space pro-

gram, reminds us of one, the NASA program, and also, more particularly, the Defense Department has had a concern with microprocessors. I think often they have been wrong in their goals, even from a purely technical standpoint, but at the same time they have probably shaped the industry to a considerable extent.

I think it is a question of not whether the Government is going to shape but how the Government is going to shape the microprocessor industry in particular, which is quite sensitive to small market changes. One way that I think that can happen, or at least one way that the focus can go away from weapons in particular is to have a center which concentrates more particularly on another way to defend our long-term future—namely to improve the conditions in the Third World. That is the reason that I think we should not rule out Government involvement; it occurs anyway.

Mr. GORE. Well, it has been a long hearing. If we supply some additional questions in writing, would you all be willing to respond to those?

Mr. GOLDHABER. Yes, sir.

Mr. OLIPHANT. Yes, sir.

Mr. GORE. Thank you very much.

I would like to thank you for coming here today. I have found it to be a most interesting hearing. It is hard to get a really firm grip on exactly what role the Government ought to play and exactly how we ought to develop this effort, but it is something that we have got to wrestle with. Thank you for helping us in that task.

The hearing is adjourned.

[Whereupon, at 1:31 p.m., the hearing was recessed, to reconvene subject to the call of the Chair.]

APPENDIX

ADDITIONAL INFORMATION SUBMITTED FOR THE RECORD

NATIONAL RESEARCH COUNCIL
OFFICE OF INTERNATIONAL AFFAIRS
2101 Constitution Avenue Washington, D.C. 20418

BOARD ON SCIENCE AND TECHNOLOGY
FOR INTERNATIONAL DEVELOPMENT

CABLE ADDRESS: NARECO
TWX #: 710-22-1586
OFFICE LOCATION:
JOSEPH HENRY BUILDING
21ST STREET AND
PENNSYLVANIA AVENUE, N.W.

July 21, 1982

Mr. James Jensen
Committee on Science and Technology
U.S. House of Representatives
Room 822, House Annex #1
Washington, D.C. 20515

Dear Jim:

With reference to some of the questions raised by Congressman Gore, at last week's hearings on measures to address the impact of computer technology on lesser developed countries, you may find the attached information on the U.K. Council for Computing Development of interest. The Council, established in June, 1981, provides a mechanism for the British computer industry, the universities, and UK government agencies to cooperate in the development of computing capabilities in developing countries.

Dr. Julian L. Bogod, former president of the British Computing Society (1979-80) played a leading role in establishing the Council.

Sincerely,

Judy Werdel

Judith A. Werdel
Professional Associate
Board on Science and Technology
for International Development

Enclosures: 2

cc: J. Daly (with enclosures)

The World Bank / 1818 H Street, N.W., Washington, D.C. 20433, U.S.A. • Telephone: (202) 477-1234 • Cables: INTBAFRAD

13 July 1982

Ms Wendy White
Board on Science and Technology for International
Development
National Academy of Sciences
2101 Constitution Avenue, NW
Washington DC 20418

UK COUNCIL FOR COMPUTING DEVELOPMENT

You may recall that your colleague Judith Werdel wrote to Don Rolt on 2 June asking for further information about the UK Council for Computing Development. I am sorry that it has taken some weeks to reply, but we have had to find out details from London.

2. The UKCCD formally came into existence in June 1981. It is a non-government, non-profit organisation funded by subscription from its members. Its aims are to "foster, coordinate and direct support by the United Kingdom in data processing and the development of computing capabilities in developing countries". It does not itself have funds to finance projects, but is expected to be a useful source of advice for developing countries in all aspects of the computing field. The aims of the Council are supported by the UK Overseas Development Administration.

3. The report in the "ESCAP News and Notes" is incorrect in stating that the (UK) Government has established the Council; ESCAP have now been notified of this, and I understand that an amendment has been issued by them in the latest edition of ESCAP News and Notes.

4. I hope that UKCCD will be letting me have further information about their activities, in which case I will of course pass it on to you.

Yours sincerely,

M A Wickstead
Office of the UK Executive Director

The UK Council for Computing Development

Julian L. Bogod

The role of computers in developing countries

Over ten years ago major studies were carried out by the United Nations into the role of computing in developing countries. Two reports were published, in 1970 and 1972, which analysed the then current state of development and identified the close relationship between computing capability and positive development. In 1978 a conference entitled 'Intergovernmental Conference on Strategies and Policies for Informatics' (SPIN) was held in Torremolinos. It was attended by some 80 nations, most of them from the developing world, and here the close relationship between computing and development was explored in depth.

In the original United Nations study four categories of computer development were identified. The first, which was called the Initial level, really covered those countries which had no effective computing capability of their own. Today such countries as Ethiopia, Lesotho and the Solomon Islands would come into this category.

The second, called the Basic level, is attained by countries which have clearly started upon the computer development road. They will have some significant use of computers in government and there will be education and training programmes in computer technology. This category would include such countries as Kenya, Nigeria, Egypt, Indonesia, Venezuela and Chile.

The third or Operational level defines the situation where computing is well established within the national environment. There will be a well identified education programme; major use of computing in government; design and production of software and maybe some hardware. Examples here are India, Singapore, Korea, Mexico and Brazil.

The fourth or Advanced level refers to those nations which are virtually capable of supporting themselves in computing terms, with fully matured design and production, professional and educational capabilities. This category would include the UK, the USA, Japan, Australia and a number of European countries.

The rate of computing development in the most industrialised nations is very advanced indeed, and we have come a long way in a mere 30 years since the early days of computing. The pace of development is still accelerating and the gap between the most advanced and the least advanced nations is widening. This gap can be analysed in a number of areas:

I. The systems gap

Successful implementation of computer systems is dependent upon there being a systems infrastructure on which to build. It is easy in advanced countries such as the UK to take this infrastructure for granted. For example, our taxation system works comparatively efficiently because it has built up over the years and because individuals, companies, banks, accountants and so on are accustomed to the procedures. Where these procedures do not exist or are inefficient, it becomes difficult if not impossible to devise a computer based system to meet the national requirement.

There is often resistance against the establishment of interdependent systems within a country which will take a very long time to be broken down at the existing pace of social change. Only by concerted national effort, sponsored by government, can the pace of change be accelerated to allow the benefits of systemisation to be attained.

II. The education gap

This is certainly the principal barrier to successful development and is at the root of the problems which developing countries face. For a country to move from the Basic to the Operational level of development implies an education programme on a national scale.

This means:

—a level of general education which will prepare the population to participate in a computer based culture. Sooner or later, directly or indirectly, all citizens will be in contact with the spreading

implementation of computer technology and will be intimately involved and affected by its applications;
—a level of general education which will provide a pool of trained minds sufficiently large to form a source of computer practitioners;
—a level of higher education which will mature the nation's computer scientists, computer professionals, and teachers;
—a level of management education which creates business, commercial and government environments where computer methods can be introduced;
—and finally, a level of technical education and training which can produce the systems analysts, programmers, operators and engineers who are necessary to develop, maintain and support the growth of applications.

III. The technology gap

It seems likely that the technology gap can never be bridged. The cost of setting out on a technological development path and catching up with the world leaders would be outside the capability of practically any nation. This does not mean that a country should not attempt to carve out a particular area of technological leadership, but there must in future always be some dependence upon the most advanced nations.

One major area where the developing countries may aspire to equality is in software technology. Certainly, the development of an indigenous capability in this area can be achieved far more quickly and far more cheaply than for hardware.

IV. The application gap

What are the applications which developing countries see as having priority? Certainly there is some common ground with the advanced countries, particularly in private industry and in government administration where the problems and the achievable benefits are of a similar nature. They are not the same, however, and this has implications for the transferability of software. Indeed the differences dictate the need for the development of indigenous software competence.

Almost certainly, it is in the public sphere that the real differences of priority exist between developed and developing countries and where they will be manifested. Examples of the sorts of activities which could be pursued are development and exploitation of natural resources. Many developing countries have immense resources available to them. They have an enormous task to turn the benefits from those resources into economic and social growth for the country as a whole. Programmes of work to achieve this require major support in planning, in project management and control and in scientific research and analysis. The resulting operational systems require continuing management. All these activities imply requirements for computer systems.

Raising educational standards. Many developing countries will have half their population under the age of 15 during the 1980s. Automated learning systems are needed to cope with the educational task.

Health care. Computers have already enabled major advances in raising the standard of health care for epidemiology and administration systems through the work of the World Health Organisation. There is further potential in this area.

Increasing food production. Raising output is a matter of improved agricultural methods, development of specialised strains, improved distribution and, above all, national planning. How do the developing countries see the priority here?

V. The power gap

As information systems develop and increasingly lie within the control of the most developed countries, particularly the USA, the developing nations are becoming increasingly concerned that their freedom to manage their own affairs might be eroded. The capacity to process information is fast becoming as valuable an international commodity as oil fuels, and the control of information is a major asset which nations would do well to guard jealously.

An illustration of this problem was quoted at the SPIN conference. The Brazilian representative reported that a factory in Brazil owned by a United States multinational has its production control system linked by satellite back to the parent company in the USA. In theory the parent company was in a position simply to turn the factory off if it so wished.

The United Nations report came to four conclusions about the role of computing in developing countries. These were:

i) 'Computer technology will increase in importance in the developing countries and its diffusion and sound application can make a significant contribution in accelerating the rate of their economic and social development'.

ii) 'Education and training for the application of computers to accelerate the process of economic and social development must receive first priority'. Thus, whilst the careful and judicious application of computers can speed up the process of national development, this can only happen if there is effective education and training first.

iii) 'Each developing country needs a broad national policy consistent with its national goals on the application of computer technology'. Obviously plans will look very different in different countries and they will depend on the current state of development, the general level of education, the higher education programme, the financial, industrial and human resources available, the status of the communications systems and the pressures of immediate priorities.

iv) 'International cooperation needs to be increased in activities relating to the application of computer technology to development'. The developing countries need help of all kinds to enable them to take advantage of world-wide computing development. It is up to the developed nations to provide support.

The United Kingdom as a source of technical assistance

It is clear that the UK has the experience and skills necessary to help the developing countries move into the information technology age. It has a mature infrastructure in computing which has developed over the last 30 years. It is possibly as advanced technically as any other country, and in some areas it leads the world. It has an educational system second to none, which at university level is nationally planned and coordinated and whose quality extends in depth to secondary level. It has a developed government machine for planning the use and development of computing in central government. It covers the full range of industry competence: hardware, software and services. The UK is also a major contributor to the establishment of international standards. The extent of user application is fairly comprehensive and sophisticated. The work of the National Computing Centre is known and highly respected throughout the UK and overseas, and the British Computer Society is one of the leading professional bodies in the world.

Whilst initiatives are taken from time to time, often in response to outside requests, for the UK to help and advise other countries in this area we do seem to have a marked inability to coordinate our resources. An example of the problem may be illustrated by referring to the visit of a UK delegation to Mexico City in 1978. The purpose of the visit was to hold a seminar on computing in the public sector for an audience of Mexican government technical and administration officials. The delegation was lead by HMG and included representatives of the UK services industry under the aegis of the Computing Services Association, ICL (the largest UK computer firm), the National Computing Council (NCC) and the British Computing Society (BCS). The intention was that we should impart useful and valuable information to the Mexican authorities and that this would be the beginning of a process of future cooperation. Whilst the conference engendered great interest amongst the delegates at the time, the event failed to achieve the objective of closer cooperation. I believe that the reasons for the failure of this mission were three-fold:

—a shortage of coordination and planning between the parties in preparation for the visit;

—a lack of direction and follow up by the UK Government, bearing in mind that government bodies are not normally empowered to take initiatives in this kind of activity;

—the industry participants believed that their investment in the mission was related to possible short term returns rather than long term investment requiring continuing dialogue and coordinated follow up.

The birth of the UK Council for Computing Development

The UK Council for Computing Development has been set up as a company limited by guarantee and having charitable status. It is funded by membership subscription and draws its expertise primarily from its members. Since the announcement of the formation of the Council in May 1981 most effort has been spent in seeking support from individuals and organisations for the proposal. As at the end of October 1981 some 70 individuals and 30 organisations have joined, providing both financial and technical viability. These organisations include a number of companies in the computing industry, users such as British Telecom and the Central Computer and Telecommunications Agency, universities and polytechnics and institutions such as the BCS, the NCC and the British Council. The Council is now operational and its immediate plans are to launch a major effort to publicise itself in the developing countries and the International Agencies, and to offer its services to those in need.

The Council will operate in two principle modes in its dealings with developing countries. It will tend to deal, in the first instance at any rate, with governmental or official bodies, and its main aim will be to establish a bilateral agreement with specific countries that the UK will help them in formulating a national computing policy and the computing development strategy that would arise from this. This in turn would lead to specific tasks such as the establishment of a national training institute, the formation of a national computing centre, setting up professional and technical standards, encouragement of an indigenous computing industry, curriculm development in education and maybe application work in areas of strategic importance to a country. In supporting these activities the Council will have a part to play in seeking funds from the appropriate

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development agencies with which it will have links of its own.

In addition to this major responsibility in respect of specific countries we may expect many requests from other countries for *ad hoc* support for particular tasks. The Council will respond to these as far as it is able within the limits of its resources.

Conclusion

The objectives of UKCCD should be seen in the context of policies in general. In the first place the aim is to help the poorer countries to help themselves, rather than to attempt to pour resources into the task of doing the job for them. In the second place the benefit should be mutual in the sense that the contributors will themselves gain in the long term from their contribution and participation. Whilst it is clear that industry participation is not going to result in the development of rapid business, most of the industry members see long term benefits to themselves in helping these countries to improve their effective and efficient use of computing, and to establish links which can be developed in the course of time.

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